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Nepalese FLORICULTURE

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"Clean environment & economic prosperity through floriculture"



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Nepalese Floriculture

"Clean environment & economic prosperity through floriculture"

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नेपाल सरकार
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फोन नं ४२७११६३५
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सिंहदरबार, काठमाण्डौं
नेपाल

पत्र संख्या :
च.नं. :

शुभकामना सन्देश

विविध भौगोलिक बनावट र हावापानी भएको हाम्रो देश नेपालमा वागवानी क्षेत्र अन्तर्गत पुष्पखेती एक उच्च सम्भावना बोकेको व्यवसाय हो । यस क्षेत्रको विकास, विस्तार र व्यवसायीकरणमा स्थापना काल देखि नै सरकारी निकायका अलवा निजि क्षेत्र र फ्लोरिकल्चर एशोसिएसन नेपाल (फ्यान) ले खेल्दै आएको नेतृत्वदायी र संगठित भूमिका प्रशंसनीय छ । एशोसिएसनका यी सार्थक प्रयासहरूमा थप ऊर्जा प्रदान गर्न कृषि, वन तथा पर्यावरण मन्त्रालयले विगतदेखि नै सहकार्य गर्दै आएको छ र आगामी दिनमा पनि यो साथ निरन्तर रहने विषयमा कृषि, वन तथा पर्यावरण मन्त्रालय प्रतिवद्व छ । हालका वर्षहरूमा पुष्पखेतीतर्फ कृषकहरूको आकर्षण बढ्दै जानु र आन्तरिक बजारको दायरा फराकिलो हुनुले यस व्यवसायलाई कृषि क्षेत्रकै एक उदीयमान निर्यातमुखी व्यवसायका रूपमा स्थापित गरेको छ । निजी क्षेत्रको सक्रियता र फ्यानको व्यावसायिक पहलकै कारण आज पुष्प व्यवसायले यो उचाइ हासिल गरेको हो ।

कृषि-पर्यावरणीय विविधताको उपयोग गर्दै स्थानीय तथा रैथाने पुष्प प्रजातिहरूको पहिचान, संरक्षण र व्यवसायीकरणका लागि मन्त्रालय प्रयासरत छ । यस सन्दर्भमा, पुष्प क्षेत्रको समग्र विकासमा नेपाल सरकारले पुष्प प्रवर्द्धन नीति २०६९ तर्जुमा र कार्यान्वयन मार्फत सरकारी संरचनाको व्यवस्था विकास गरि विदेशि फूलहरुको प्रयोगलाई निरुत्साहित गर्न आयात प्रतिबन्ध जस्ता कदम मार्फत स्वेदेशी उत्पादन र उत्पादकत्व वृद्धि गर्ने, निर्यातमा सहुलियत प्रदान गर्ने र प्रविधि हस्तान्तरणलाई प्राथमिकता दिने काम भइरहेका छन् । मन्त्रालयले पुष्प नर्सरी व्यवस्थापन, पुर्वाधार विकास र बजारीकरणका लागि आवश्यक प्राविधिक तथा वित्तीय सहयोगका कार्यक्रमहरूलाई संघ, प्रदेश र स्थानिय तह मार्फत वार्षिक बजेट र योजनामा समावेश गर्दै आएको छ । स्वदेशी उत्पादनलाई प्रोत्साहन गरी आयात प्रतिस्थापन गर्ने र नेपाली उत्पादनलाई अन्तर्राष्ट्रिय बजारसम्म पुर्याउन नीतिगत सहजिकरण गर्नु हाम्रो मुख्य लक्ष्य रहेको छ ।

फ्लोरिकल्चर एशोसिएसन नेपालले १९ औं गोदावरी फूलको प्रतियोगितात्मक प्रदर्शनीको सुखद अवसरमा विविध खोजमूलक लेख-रचनाहरू समेटिएको "नेपालीज फ्लोरिकल्चर" को २८ औं संस्करण प्रकाशन गर्न लागेकोमा मलाई अत्यन्त खुसी लागेको छ । यो पुस्तक पुष्प व्यवसायमा रुचि राख्ने व्यवसायी, उद्यमी, विद्यार्थी तथा अनुसन्धानकर्ताहरूका लागि एक महत्वपूर्ण सन्दर्भ सामग्री बन्नेछ भन्ने मेरो विश्वास छ ।

अन्त्यमा, पुष्प क्षेत्रको संस्थागत विकास र आत्मनिर्भरता तर्फको यात्रामा यो प्रकाशन कोशेढुङ्गा सावित होस् भन्दै फ्लोरिकल्चर एशोसिएसन नेपाल, यसका सम्पूर्ण पदाधिकारी एवं सदस्यहरूलाई नेपाल सरकार, कृषि तथा पशुपन्छी विकास मन्त्रालय र मेरो व्यक्तिगत तर्फबाट हार्दिक बधाई तथा शुभकामना व्यक्त गर्दछु ।

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डा. राजेन्द्र प्रसाद मिश्र
सचिव
कृषि तथा पशुपन्छी विकास मन्त्रालय
मितिः २०८३/०६/२६

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शुभ–कामना

नेपालको भौगोलिक बनावट सबै प्रकारका फूल उत्पादनका लागि उपयुक्त मानिन्छ । यस महासंघको सदस्य फलोरिकल्चर एसोसिएसन नेपालले हरेक वर्ष आयोजना गर्दै आएको पुष्प मेलाले मुलुकभित्र व्यवसायिक पुष्प खेतीको प्रवर्द्धनमा ठूलो सहयोग गरेको छ । संघकै अनवरत प्रयासका कारण फूलको आन्तरिक खपत वृद्धिका साथै विस्तारै निर्यात समेत हुन थालेको छ ।

नेपालमा पनि फूलको माग निरन्तर बढी रहेको छ । आन्तरिक मागको धेरैजसो प्रतिशत स्वदेशी उत्पादनले पुरा गर्न थालेको छ । केही प्रतिकुल परिस्थिति नभैदिएको भए आन्तरिक मागलाई स्वदेशी उत्पादनले पुरा गर्ने अवस्था बनिसक्ने थियो । राजनीतिक, प्राकृतिक लगायतका विभिन्न कारणबाट समयसमयमा प्रभावित हुदै आएको पुष्प व्यवसाय अहिलेसम्म पनि राम्रोसंग तङग्री नसकेको स्वयम् पुष्प व्यवसायी साथीहरुबाट सुनेको छु ।

स्वदेशी पुष्प व्यवसायलाई फस्टाउने वातावरण बनाउन आन्तरिक उत्पादनको प्रवर्द्धन एवं खपतमा जोड दिनुपर्ने, पुष्प नीतिलाई संघीय संरचना अनुसार परिमार्जन गर्नुपर्ने, पुष्प व्यवसायी कृषकहरूको हकमा भ्याटमा अनिवार्य जानुपर्ने प्रावधान हटाउनुपर्ने लगायतका सुझावहरू संवोधन हुनुपर्नेमा महासंघको पनि जोड छ । अव बन्ने नयां सरकारले पुष्प लगायत प्रमुख कृषि उत्पादनको प्रवर्द्धनका लागि विशेष नीति ल्याउने अपेक्षा निजी क्षेत्रले गरेको छ ।

यस वर्ष कार्तिक १२ देखि १६ गतेसम्म ललितपूरमा हुने १९ औं गोदावरी फूलको प्रतियोगितात्मक प्रदर्शनी को अवसर पारेर एसोसिएसनले प्रकाशन गर्न लागेको Nepalese Floriculture Book पुष्प व्यवसाय गर्न चाहना राख्ने सबैलाई महत्वपूर्ण सन्दर्भ सामग्री हुने मेरो विश्वास छ । साथै, पुष्प परनिर्भरता चाँडै हटाई मुलुकका लागि आवश्यक सबै प्रकार र जातका फूलहरू उत्पादन गरी राष्ट्रिय आवश्यकता पुरा गर्न यहाँहरूलाई सफलता मिल्दै जाओस भन्ने शुभेच्छाका साथ उत्तरोत्तर प्रगतिको कामना गर्दछु ।

अन्त्यमा, १९ औं गोदावरी फूलको प्रतियोगितात्मक प्रदर्शनी र Nepalese Floriculture Book Volume २८ प्रकाशन कार्यको पूर्ण सफलताका लागि हार्दिक शुभ-कामना व्यक्त गर्दछु ।

(अन्जन श्रेष्ठ)
अध्यक्ष

मितिः २०८३ असोज २० गते ।

Regd. No. 244/049/50

फ्लोरिकल्चर एशोसिएसन नेपाल
Floriculture Association Nepal (FAN)

Ref.:

सन्देश



फ्लोरिकल्चर एशोसिएसन नेपाल (फ्यान) ले देशभरका सम्पूर्ण पुष्प व्यवसायी सदस्यहरूको हक-हितलाई उच्च प्राथमिकतामा राख्दै निरन्तर रूपमा पुष्प व्यवसायको विकास, विस्तार र प्रवर्द्धनमा सक्रिय भूमिका निर्वाह गर्दै आएको छ। विगतका वर्षहरूमा सरकारी लगानी विना नै निजी क्षेत्रको एकल प्रयासबाट नेपाली पुष्प व्यवसायले उल्लेखनीय उपलब्धि हासिल गरेको छ।

पुष्प प्रवर्द्धन नीति २०६९ लागू भएपछि नेपाल सरकार, कृषि तथा पशुपन्छी विकास मन्त्रालय तथा मातहतका निकायहरूसँगको सहकार्यले यस क्षेत्रलाई थप गति दिएको छ। हाल नेपालका ५४ जिल्लामा ३२५ हेक्टरभन्दा बढी क्षेत्रफलमा पुष्प खेती भइरहेको छ। १,४४५ भन्दा बढी व्यवसायी यस क्षेत्रमा संलग्न छन्। अनुमानित लगानी रु.११ अर्ब भन्दा बढी रहेको छ भने प्रत्यक्ष तथा अप्रत्यक्ष रूपमा ६३,५०० भन्दा बढी जनशक्ति रोजगारीमा आबद्ध रहेको छन्। आ.ब.२०८२/०८३ मा पुष्प तथा पुष्पजन्य वस्तुको वार्षिक कारोबार रु. ३ अर्ब ९४ करोडभन्दा बढी पुगेको छ। हरेक वर्ष १० देखि १५ प्रतिशतका दरले बजार माग बढिरहेको भएतापनि आन्तरिक उत्पादनले अझै पूर्ण रूपमा माग धान्न सकेको अवस्था छैन। बजार माग र आपूर्तिको सन्तुलन कायम गर्न फ्यानले सरकार, संघ-संस्था तथा उद्यमी व्यवसायीहरूसँग निरन्तर संवाद, सहकार्य र पहल गर्दै आएको छ।

पुष्प व्यवसायले विभिन्न समयखण्डमा विविध समस्या र चुनौतीहरूको सामना गर्नुपरेको छ। ती चुनौतीहरू समाधान गर्न र व्यवसायीहरूलाई सहज वातावरण उपलब्ध गराउन हामी निरन्तर क्रियाशील छौं। यस क्षेत्रको दिगो विकासका लागि नीतिगत सुधार, वैदेशिक लगानी भित्र्याउने पहल तथा आवश्यक संरचनात्मक सुधारका लागि सम्बन्धित निकायहरूसँग सहकार्य गरिरहेका छौं। साथै, पुष्प बालीलाई प्राथमिकतामा राखी संघीय संरचनामा समावेश गराउन तथा पुष्प प्रवर्द्धन नीतिलाई पुनरावोलोकन गरी कार्यान्वयन गर्न आवश्यक पहल जारी छ।

पुष्प उद्योगको पूर्वाधार विकास, नीतिगत व्यवस्थापन, दक्ष जनशक्ति उत्पादन तथा प्रविधि हस्तान्तरणमा सरकारी लगानी अत्यावश्यक छ। उच्च प्रविधियुक्त ग्रिनहाउस, थोपा तथा मिष्ट सिँचाइ प्रणाली, वाटर-सोल्युबल फर्टिगेसन सिस्टम तथा रोग-किरा नियन्त्रणयुक्त आधुनिक प्रविधि भित्र्याएर उत्पादन वृद्धि र गुणस्तर सुधार गर्नुपर्ने आवश्यकता छ। यस्ता प्रविधिको प्रयोगबाट आन्तरिक रूपमा गुणस्तरीय उत्पादन वृद्धि हुने मात्र नभई अन्तर्राष्ट्रिय बजारमा प्रतिस्पर्धा गर्न सक्षम उत्पादन विकास गर्न सकिनेछ। यसमार्फत विश्व पुष्प बजारमा नेपालको पहुँच विस्तार हुने विश्वास लिएका छौं।

साथै, पुष्पका लागि विशेष पूर्वाधारयुक्त छुट्टै बजार विकास गर्नु समयको माग हो। यस कार्यका लागि सम्बन्धित मन्त्रालय तथा निकायहरूको सहयोग अपरिहार्य छ।

अन्त्यमा, नेपाल सरकारका सम्बन्धित अंगहरू, उद्यमी व्यवसायीहरू, विज्ञहरू, पदाधिकारी तथा कर्मचारीहरूलाई पुष्प व्यवसाय र एशोसिएसनलाई निरन्तर प्रदान गर्नुभएको सल्लाह, सुझाव र सहयोगका लागि हार्दिक धन्यवाद सहित कृतज्ञता जाहेर व्यक्त गर्दछु। आगामी दिनहरूमा पनि यहाँहरूको साथ, सहयोग र सहकार्य निरन्तर रहनेछ भन्ने पूर्ण विश्वास लिएको छु।

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सम्पादकीय

प्राकृतिक स्रोत र साधनका दृष्टिले सम्पन्न मुलुकमित्र रहेर पनि आफ्नो कुल उपभोगको आधाभन्दा बढी पुष्पजन्य वस्तु आयातमार्फत धान्नुपर्ने अवस्था नेपालको पुष्प व्यवसायको वर्तमान यथार्थ हो । उपलब्ध स्रोत-साधनको अधिकतम उपयोग र तिनको दिगो व्यवस्थापनबाट मात्र कुनै पनि मुलुकको आर्थिक समुन्नति सम्भव हुन्छ । यो सामान्य र सर्वस्वीकार्य सिद्धान्त हुँदाहुँदै पनि बढ्दो आन्तरिक मागलाई तत्काल सम्बोधन गर्न आयातमा निर्भर रहनुपर्ने बाध्यता हाम्रो सामु विद्यमान छ । पछिल्ला केही वर्षदेखि स्वदेशी पुष्प उत्पादनलाई प्रोत्साहन तथा विदेशी पुष्पजन्य वस्तुको आयातलाई निरुत्साहित गर्ने उद्देश्यले सरकारले भन्सार महसुल लगायतका शुल्क जन्य अवरोध (Tariff Barrier) तथा गैर-भन्सार अवरोध (NonTariff Barrier) का विभिन्न व्यवस्था गर्दै आएको छ । यद्यपि, भन्सार अभिलेखमा देखिने आयातको परिमाणभन्दा वास्तविक बजारमा हुने पुष्पजन्य वस्तुको प्रवाह र खपतलाई समग्र रूपमा विश्लेषण गर्ने हो भने आयात-निर्भरता अझै गम्भीर रहेको देखिन्छ । यस अवस्थाले स्वदेशी उत्पादनको क्षमता विस्तार, प्रतिस्पर्धात्मकता वृद्धि र बजार व्यवस्थापनमा थप गम्भीर तथा दीर्घकालीन पहल आवश्यक रहेको स्पष्ट संकेत गर्दछ ।

'उत्पादन देशभित्रै गर्नुपर्छ' भन्न जति सहज छ, व्यवहारमा त्यसलाई कार्यान्वयन गर्न त्यति नै चुनौतीपूर्ण छ । कमजोर पूर्वाधार, आधुनिक प्रविधिको सीमित पहुँच, अनुसन्धान तथा प्राविधिक सेवाको अभाव, उत्पादनपछिको व्यवस्थापन, भण्डारण तथा ढुवानीका समस्या र व्यवस्थित बजार संरचनाको कमीका कारण गुणस्तरीय तथा प्रतिस्पर्धी उत्पादन विस्तार गर्न कठिनाइ भइरहेको छ । तथापि, करिब डेढ दशकको निरन्तर प्रयासपछि सयपत्री फूलको स्वदेशी उत्पादन विस्तार हुँदै जानु उत्साहजनक उपलब्धि हो । हालको उत्पादनले देशको कुल मागको एक चौथाइ हिस्सा पनि सहज रूपमा धान्न नसके पनि यसले आयात प्रतिस्थापन, रोजगारी सिर्जना र व्यवसाय विस्तारको ठूलो सम्भावना देखाएको छ । सयपत्री उत्पादनको यो अनुभव आगामी दिनमा अन्य पुष्पजन्य वस्तुको स्वदेशी उत्पादन विस्तारका लागि महत्वपूर्ण उदाहरण बन्न सक्छ । कुनै पनि उद्योगको दिगो विकासका लागि सरकार र निजी क्षेत्रबीच प्रभावकारी समन्वय र सहकार्य अपरिहार्य हुन्छ । निजी क्षेत्रले लगानी, उत्पादन, उद्यमशीलता तथा बजार विस्तारमा भूमिका निर्वाह गर्ने र सरकारले अनुसन्धान, प्रविधि विकास, पूर्वाधार निर्माण, नीतिगत सहजीकरण तथा बजार व्यवस्थापनमा प्रभावकारी भूमिका निर्वाह गर्न सकेमा नेपालको पुष्प व्यवसायलाई आत्मनिर्भर, प्रतिस्पर्धी र निर्यातमुखी उद्योगका रूपमा विकास गर्न सकिन्छ ।

फ्लोरिकल्चर एशोसिएसन नेपाल (फ्यान) ले विगत तीन दशकदेखि मेला तथा प्रदर्शनी, महोत्सव, तालिम, चेतनामूलक कार्यक्रम, अन्तरक्रिया तथा विभिन्न प्रकाशन मार्फत नेपालको पुष्प व्यवसायको विकास, विस्तार र प्रवर्द्धनमा निरन्तर नेतृत्वदायी भूमिका निर्वाह गर्दै आएको छ । निजी क्षेत्रको सक्रियताले पुष्प व्यवसायको बजार विस्तार तथा उपभोक्ताको रुचिमा सकारात्मक परिवर्तन ल्याए पनि अनुसन्धान, प्रविधि र नीतिगत विकासमा अझ तीव्रता आवश्यक छ । बढ्दो आयातलाई न्यूनीकरण गर्दै स्वदेशी उत्पादन मार्फत आत्मनिर्भरतातर्फ अघि बढ्न अब सरकार, निजी क्षेत्र, अनुसन्धान संस्था र सम्पूर्ण सरोकारवालाबीच ठोस र परिणाममुखी सहकार्य आवश्यक छ ।

सूचना, प्रविधि तथा ज्ञानको आदानप्रदान गर्ने उद्देश्यले फ्यानले प्रत्येक वर्ष पुष्प व्यवसायसँग सम्बन्धित लेख, अनुसन्धान, नवीन प्रविधि तथा व्यावसायिक अनुभव समेटेर वार्षिक प्रकाशन गर्दै आएको छ । यही निरन्तरताको रूपमा यस वर्ष 'नेपालीज फ्लोरिकल्चर' को २८ औँ संस्करण यहाँहरूसमक्ष प्रस्तुत गर्न पाउँदा हामी गौरवान्वित छौँ । यस संस्करणमा नेपालको पुष्प व्यवसायको वर्तमान अवस्था, नवीन प्रविधि, आधुनिक उत्पादन प्रणाली, बजारका सम्भावना तथा चुनौतीलगायत विविध विषयमा आधारित उपयोगी तथा ज्ञानवर्द्धक लेख-रचनाहरू समावेश गरिएका छन् । यो प्रकाशन पुष्प उद्यमी, व्यवसायी, कृषक, अनुसन्धानकर्ता, विद्यार्थी, नीति-निर्माता, सरकारी तथा गैरसरकारी निकाय र सम्पूर्ण पुष्पप्रेमी महानुभावहरूका लागि उपयोगी सन्दर्भ सामग्री बन्ने विश्वास लिएका छौँ ।

अन्तमा, यस प्रकाशनका लागि अमूल्य लेख-रचना तथा अनुसन्धान सामग्री उपलब्ध गराउनुहुने लेखकहरू, आर्थिक तथा प्राविधिक सहयोग गर्नुहुने विज्ञापनदाता, प्रायोजक, विज्ञ तथा प्रत्यक्ष-परोक्ष रूपमा सहयोग गर्नुहुने सम्पूर्ण महानुभावहरूप्रति हार्दिक आभार व्यक्त गर्दछौँ । आगामी दिनमा 'नेपालीज फ्लोरिकल्चर' लाई अझ परिष्कृत, समयसापेक्ष, अनुसन्धानमुखी र गुणस्तरीय बनाउँदै लैजान यहाँहरूको रचनात्मक सुझाव तथा निरन्तर सहयोगको अपेक्षा गर्दछौँ । फूल केवल सौन्दर्यको प्रतीक मात्र होइन; यो रोजगारी, उद्यमशीलता, वातावरणीय सन्तुलन र आर्थिक समृद्धिको आधार पनि हो । यसै विश्वासका साथ स्वदेशी पुष्प व्यवसायको विकास, विस्तार र प्रवर्द्धनमा सबैको निरन्तर सहकार्यको अपेक्षा गर्दछौँ ।

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Stenting of Roses: A Rapid Vegetative Propagation Technique

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1. Introduction

Rose (Rosa spp.) is one of the most important and globally popular ornamental plants, extensively used for cut flowers and landscaping. Rose is considered as king of flowers and taken as a symbol of love. Although roses are best known for their ornamental value, they are also widely used in cosmetic and beauty industries, and in traditional medicines. In Nepal, the commercial significance of roses has escalated with increasing urbanization, particularly in the markets of Kathmandu Valley and other major cities. Every day, the Nepalese floral market demands 8000-10000 rose sticks (FAN, 2025). Currently, about 6 ha of area is occupied by rose farms in Nepal, which is expanding at the rate of about 0.2 ha annually (FAN, 2025). With the expansion of cultivated area, the demand for quality plantlets with high yield potentials and market-preferred characteristics is increasing day by day. To meet the demand for high-quality, long-stemmed roses, growers must utilize propagation methods that ensure genetic fidelity, high vigor, and rapid production cycles.

What is Stenting ?

Stenting is a quick method of vegetative propagation developed in the Netherlands. The word stenting is derived from the Dutch words Stekken (to strike a cutting) and enten (to graft), describing a method where cutting and grafting are executed simultaneously in one action (Van de Pol and Breukelaar, 1982; Kroin and Usa, 2015). In stenting, the formation of graft union and generation of adventitious roots in rootstock take place at the same time, and the resulting plantlet is known as a stentling.

3. Why Stenting ?

Growers conventionally propagate roses through cutting, budding, and grafting. Grafted rose saplings are preferred for commercial plantation as they possess a strong root system from vigorous local cultivars, resulting in higher productivity and quality production compared to plants from cuttings. However, conventional grafted plant production takes almost two years. During the first year, the rootstocks are produced from cuttings, and when they attain pencil-sized thickness with well-established roots, the grafting/budding operations are performed. The grafted plants take another year to become ready for field plantation. On the other hand, in the stenting technique, graft union formation and rooting occur simultaneously, making it an innovative technique for rapid clonal multiplication. Stenting is being used extensively all over the world for rose propagation (Nazari et al., 2009).

Advantages of stenting

The main advantages of stenting in rose can be enlisted as follows (Kroin and Usa, 2015; Rawat and Das, 2020):

- The grafted plant can be produced within a year, thereby reducing the nursery duration.
- The reduced nursery duration lowers the production cost, thereby making grafted plant production more profitable for nursery-men and more affordable for consumers.
- The stenting technique is ideal for screening new scion/rootstock combinations and can be used for faster evaluation of scion-rootstock interaction.

- It helps in utilizing the beneficial effects of rootstocks like disease and pest resistance, abiotic stress tolerance, productivity enhancement, etc.
- Stenting can be done all year round in a greenhouse.

Are there any disadvantages of stenting?

- The success rate is relatively low compared to traditional grafting methods in stenting because the graft union formation and rooting must take place at the same time (Rawat and Das, 2020).
- It requires specialized skill.
- Chances of disease spread are high from the grafting tools and vegetative parts if proper precaution is not taken.
- The lifespan of grafted plants is relatively shorter compared to seed-propagated or tissue-cultured plants (Hartmann et al., 2v002).

4. Tools Required for Stenting

The essential tools for stenting include:

- A secateur for preparing the rootstocks and scions.
- A very sharp and sterile grafting knife.
- Rooting hormone.
- Suitable growing media.
- Materials to hold the graft union togethereg. grafting tape or polyethelene tape.
- A humidity chamber or a simple plastic cover to prevent the scion and rootstock from wilting.

5. Steps of Stenting

- **Preparation of the rootstock:** Select pencil-sized thick semi-hardwood cuttings (around 6-8 mm in diameter) from vigorous rootstock cultivars like Rosa indica. Single internode cuttings are appropriate to reduce the chances of future sucker sprouting. Remove all leaves, thorns, and buds from the selected cutting.
- **Preparation of the scion:** Scions must be harvested from healthy, disease-free commercial cultivars. Each scion should possess a dormant bud and a healthy leaf. The thickness of the scion should be same as the thickness of the rootstock.
- **Grafting:** The base of the scion and the top of the rootstock are held together and simultaneously cut smoothly at a 45° angle, creating matching clean surfaces that fit perfectly together and they are splice grafted (Park and Jeong, 2010). Alternatively, cleft or wedge graft can be performed at the proximal end of the rootstock cutting. The union should be wrapped tightly with grafting/polyethylene tape.
- **Use of rooting hormone:** To hasten the rooting process, dip the base of the rootstock cutting in commercial rooting hormone.
- **Planting the stentlings:** Place the stentlings in a rooting substrate such as peat moss, sand, cocopeat, or perlite. Among the different rooting substrates, the substrates providing optimal aeration and moisture balance are considered appropriate for stent planting.
- **Creating a humid environment:** Place the planted stentlings in a high-humidity environment (above 95% RH). A simple plastic bag tent or a misting chamber will maintain the humidity and prevent the scion from wilting while the vascular tissues are still underdeveloped. Humidity should be maintained for 30 days after planting stentlings.

- **Aftercare of stentlings:** For successful stenting, the plants should be kept in bright, indirect light while maintaining high humidity (more than 95% RH). The sign of successful stents is visible after 3-4 weeks, when new growth emerges from the scion's bud, indicating successful graft union and root emergence. The humidity should be gradually lowered after the emergence of new sprouts on the scion.



Fig.1. Steps of stenting in rose: a) Rootstock and scion connection, b) Activated lateral bud of scion, c) Callus formation at the base of rootstock, d) Emergence of primary roots and shoot, e) Full growth of stentling, f) Plantation and growth in the greenhouse (Adapted from Pourghorban et al., 2020)

6. Factors Affecting Stenting Success Rate

6.1 Rootstock selection

Species/Variety: The characteristics of the rootstock are the most critical factor for successful stenting. Rooting abilities differ with rootstock varieties. Among the different rootstocks, Rosa indica 'Major' is frequently cited as an excellent rootstock with high success rates (Van de Pol and Breukelaar, 1982).

Rootstock diameter and maturity: The optimal diameter for best results is 6-8 mm with mature internodes. Adequate supply of stored carbohydrates and other resources necessary for root initiation and graft union formation may be stored in mature internodes of 6-8 mm diameter (Van de Pol and Breukelaar, 1982).

6.2 Scion-rootstock preparation

Preparation of rootstock cuttings: Recent studies have shown that the bottom and middle positions of stems should be used as rootstocks for successful stenting (Sarkari et al., 2024). All buds of the rootstock cutting should be removed to prevent sucker generation which competes with the scion (Van de Pol and Breukelaar, 1982; Park and Jeong, 2010).

Preparation of scion cuttings: The scion should be prepared as a single node with one five-leaflet leaf attached (Park and Jeong, 2011). The attached leaf helps to maintain transpiration pull and photosynthetic activity during the initial healing phase.

6.3 Grafting technique and precision

Grafting method: The most critical factor during this step is the precise alignment of the cambium layers of both the scion and the rootstock, which ensures the vascular continuity required for callus bridge formation(Hartmann et al., 2002). The omega grafting method has been found to be superior to splice grafting with 66.66% success rate, which might be due to the larger area of cambium contact and properly locked scion and rootstock (Izadi et al., 2013).

Precision: A clean, precise cut is very important. The base of the scion and the top of the rootstock are held together and cut simultaneously at a 45-degree angle to create perfectly matching surfaces.

6.4 Hormonal treatment

Applying rooting hormones like IBA on the base of rootstock cuttings stimulates rooting (Izadi et al., 2013). Yeshiwas et al. (2015) found that cuttings treated with 1000 ppm IBA showed significant effects on root length, number of roots per cutting, and shoot length.

6.5 Propagation environment

Light intensity: Higher light intensity, especially in winter, accelerates root growth and increases the rooting percentage. Shading was not found to be necessary and could even be detrimental (Park and Jeong, 2011).

Rooting medium: A mixture of sand and peat (1:1) is identified as an excellent medium, promoting high rooting percentages (Edrisi et al., 2017). Similarly, 70% perlite and 30% cocopeat also showed the highest root number in stentlings (Sarkari et al., 2023). A preliminary study conducted at the Floriculture Development Center, Godawari, revealed that peat moss (success rate: 61.5%) is more suitable for stenting compared to sand (success rate: 41%).

Humidity and temperature: After stenting, the plant enters a complex physiological and biochemical stage where the graft must heal and rooting must occur side by side. Maintaining high humidity for the first few weeks is key for successful stenting (Izadi et al., 2013; Park and Jeong, 2011). Optimum temperature for graft union healing was found to be 29°C ± 2°C (Izadi et al., 2013). Proper aeration and moisture management in rooting media is another key factor.

6.6 Post-propagation handling

Even after successful stenting, how the plantlet is after-cared determines its establishment. Stentlings should be transplanted timely after rooting. Delaying transplanting can lead to senescence of the new roots, which adversely affects future growth and yields (Park and Jeong, 2012). Immediately remove suckers appearing from the grafted rootstock.

7. Important Factors to be Considered While Stenting

- Never use dull blades for stenting. A dull blade crushes the plant tissue, creating a barrier of dead cells that prevents callusing.
- Never let the scion and cut surfaces dry out. Work as quickly as possible to avoid desiccation.
- Perfectly align the cambium layer of the scion and rootstock and hold them firmly together.
- Never let the humidity drop in the stenting chamber. If the environment is dry, the scion's leaf will wilt and die before root formation occurs.

8. Conclusion

Stenting is a quick vegetative propagation techniquethat executes grafting and cutting in a single

action, enabling simultaneous formation of the graft union and adventitious roots in roses. This novel propagation technique significantly reduces the nursery duration, lowers production costs, and allows for rapid evaluation of new scion-rootstock combinations. The success of stenting depends on multiple factors including appropriate rootstock selection (species, diameter, and stem position), proper scion preparation with a healthy leaf and a dormant bud, precise grafting technique with clean cuts and proper cambial alignment, appropriate use of rooting hormones, selection of suitable rooting media, and maintenance of optimal environmental conditions such as high humidity and adequate light intensity. Despite its lower success rate compared to traditional methods and requirement for specialized skill, stenting offers substantial advantages for commercial rose sapling production. For Nepalese rose growers and nurseries, adoption of stenting technology presents opportunities to improve production efficiency, reduce costs, and introduce new cultivars more rapidly to meet the growing market demand.

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Versatile *Canna indica*; from phytoremediation to medicinal properties

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Urban environment faces major challenges from pollution, ecological decline, and climate change. This calls for design solutions that focus on sustainability and resilience. One of the method to address the issue is the use of *Canna indica* plant which can be used for several purposes such as eco-smart roadscapes that incorporate green infrastructure to boost biodiversity, improve appearance, and enhance urban air quality. On the other hand, it has different phytochemicals which can serve as medicine. *Canna indica* is one of the versatile species which can overcome these challenges. Canna has capacity to remove heavy metals like Cadmium (Cd), Lead (Pb), Nickel (Ni), and Zinc (Zn) from polluted environments, making it a strong candidate for urban restoration projects aimed at lowering pollution in soil and water (Morales-Hernández et al., 2022; Luo et al., 2022).

Developing eco-smart roadscapes with *Canna indica* addresses urban pollution while supporting broader efforts in climate adaptation and sustainability. Green spaces with plants that can clean the soil can help combat urban heat islands, decrease stormwater runoff, and boost urban biodiversity (Бакаева et al., 2021; Salmond et al., 2016). Furthermore, urban greening projects are advantageous for public health and community ties by giving residents access to nature in crowded areas (Bowler et al., 2010; Bahrini et al., 2017). As cities grow and climate challenges increase, adding *Canna indica* to roadscapes offers a scientifically sound way to tackle environmental decline while also enhancing visual appeal.

Furthermore, many studies has shown that *Canna indica* can greatly lower Chemical Oxygen Demand (COD) and nutrient levels in dairy wastewater (Sun et al., 2021; Barya et al., 2020). Its rapid growth and high biomass production increase its effectiveness in urban areas, allowing it to absorb significant pollutants in just weeks. This is crucial for cities focused on eco-friendly practices that elevate both functionality and aesthetics (Barya et al., 2020; Lokesh et al., 2023). Additionally, *Canna indica* shows strength against environmental stresses, including high concentrations of contaminants, which highlights its reliability as a plant for rehabilitation in urban planning (Lokesh et al., 2023; Luo et al., 2022).

Canna indica is a two-in-one species that can be used for ecological restoration and urban beauty in eco-smart roadscapes. Its proven effectiveness in phytoremediation makes it a strong choice for tackling urgent environmental problems in urban areas while also enhancing *Canna indica* landscaping and ecological health.

Not only that, Phytochemical analyses of *Canna indica* have shown a variety of bioactive compounds, such as polyphenols, flavonoids, anthocyanins, and starch (Taher et al., 2024; Vankar& Srivastava, 2010; Kanase & Vishwakarma, 2018; Madhu et al., 2025; Kumbhar et al., 2018; Srivastava &Vankar, 2010; Vankar& Srivastava, 2008) which have many therapeutic and medicinal value.

However, despite the many applications of *Canna indica*, there is still a lack of systematic understanding of its features. This study presents an opportunity to explore new design methods that leverage *Canna indica's* diverse benefits for health, sustainability and resilience



Fig.1. Beautiful blooms if canna indica from Eastern area of Nepal

Literature Review

Potential for Phytoremediation

Canna indica is increasingly noted for its phytoremediation capabilities, particularly in urban areas where pollution is a prevailing problem. Research studies show that *Canna indica* is one of the plants that are efficient at removing heavy metals and excess nutrients in both soil and water. Its robust growth and a very extensive root system give rise to effective stabilization and detoxification of pollutants, making it an ideal species for use in constructed wetlands or bioretention systems. Under good conditions, these plants can reduce Chemical Oxygen Demand and Biological Oxygen Demand, critical parameters for which urban wastewater treatment system improvements are necessary. This highlights its suitability for urban areas that are trying to improve their environmental quality and manage stormwater runoff effectively.

Béral et al. (2025) again reinforce this by discussing how bioretention cells, most of which use a number of plant species including *Canna indica*, act to reduce the hydrological and pollutant impacts common with urban runoff. Interacting together in their bioretention installations, these plants provide an improved urban landscape both in managing water and its quality. As urban infrastructure continues to develop, incorporating such plants into the design offers dual benefits in terms of aesthetic enhancement and functional ecological performance.

Many researches showed that *Canna indica* effectively accumulates and moves heavy metals from contaminated soils which assist in reducing harmful industrial sludge. Specifically, *Canna indica* can be used for phytoremediation of metals such as lead, zinc, and cadmium, which further assist in managing industrial waste (Bose et al., 2008). This ability positions *Canna indica* as not only an useful plant for ecological restoration but also as a resource for biomass energy, reinforcing its importance in urban planning through sustainable waste management (Bose et al., 2008). Many studies indicated that *Canna indica* is chosen for its high efficiency in removing nitrogen and phosphorus in constructed wetland systems (Sonu et al., 2021). The ability of *Canna indica* to remove nutrients from wastewater further highlights its relevance in promoting ecological health in cities (Sharma et al., 2014). Optimizing such plant-based systems can aid in managing urban waste and promote sustainable energy solutions through biomass generation (Munavalli et al., 2020).

Urban Climate Regulation

Beyond its utility in pollutant remediation, *Canna indica* also plays an important role in regulating local climates, particularly in urban settings. Vegetation in roadside plantings can mitigate the effects of urban heat islands through temperature stabilization and improved air circulation, an essential consideration in order to allow for comfortable and sustainable urban living conditions (Morash et al., 2019). Indeed, studies have shown that strategically planned vegetation can reduce the air temperature, contributing to lower levels of energy consumption for cooling urban air, especially during hot months (Morash et al., 2019). Moreover, plants such as *Canna indica* improve the thermal performance of the built environment through the process of shading and cooling, which is particularly crucial in highly dense cities such as Jhapa.

The work of Adkins & Shabbir (2014) further shows that incorporation of plants like *Canna indica* adds to aesthetic appeal but also supports a more favorable microclimate-temperature extreme often characteristic of the urbanizing environment. Application of eco-smart roadside plantings with *Canna indica* constitutes one holistic approach to urban greenery that shows environmental benefits and favors better health in urban settings.

Economic and Social Dimensions

The potential use in road-side plantings is also promising for the economy of *Canna indica*. The establishment of Canna in public places could increase property value and eventually develop tourism in those areas, adding to urban beautification and ecosystem services. This agrees with the notions taken up by the work of Cadman et al. (2023) on the sustainable management of community resources through gardening and green infrastructure, bringing about positive change in the well-being and economic growth of a community.

The contribution of *Canna indica* to increasing urban biodiversity is not to be underestimated. Invasive introduction of such plant species would help restore local ecosystems as it attracts useful fauna that includes pollinators, which are essential in different urban gardens and agriculture. The involvement of such a new ecosystem in built-up areas in orders to achieve sustainability and resilience, and thus called for a re-evaluation of community perceptions towards alien species that confer ecological advantages.

Therefore, the description of *Canna indica* for eco-smart roadspace development provides a diversified approach for sustainable urban development. Instead, its role for effective bioremediation, microclimate regulation, economic development, or improving urban biodiversity makes it a crucial resource for current urban biotic structures.

Phytochemicals and medicinal importance

Phytochemical analyses of *Canna indica* have shown a variety of bioactive compounds, such as polyphenols, flavonoids, anthocyanins, and starch (Taher et al., 2024; Yadav et al., 2019; Vankar& Srivastava, 2010; Kanase&Vishwakarma, 2018; Madhu et al., 2025; Kumbhar et al., 2018; Srivastava &Vankar, 2010; Vankar& Srivastava, 2008). For example, studies found four different anthocyanin pigments, along with quercetin and lycopene, in the red flowers of *Canna indica* (Srivastava &Vankar, 2010). The flower extracts also show significant levels of total phenolic and flavonoid content, which help its antioxidant capacity (Vankar& Srivastava, 2010; Madhu et al., 2025; Vankar& Srivastava, 2008). Research on the rhizomes of *C. indica* has highlighted the presence of

various phytochemicals that offer biological benefits, including antimicrobial, anthelmintic, and antidiabetic effects (Kumbhar et al., 2018). The rhizomes are also a good source of starch, with studies examining its properties and functions, including changes made through esterification and acid hydrolysis to improve its industrial use (Algar et al., 2019; Putri et al., 2016; Chandrasekaran et al., 2025). Improved ultrasound-assisted extraction (UAE) methods have been developed to increase yields of starch and polyphenols from *C. indica* rhizomes. These methods consider factors like temperature, time, and solid-to-liquid ratio to enhance extraction efficiency (Chandrasekaran et al., 2025).

Traditionally, *Canna indica* has been used in various ethnomedicinal practices to treat several ailments (Darsini & Shamshad, 2015; Kanase & Vishwakarma, 2018). Modern scientific studies have started to confirm some of these traditional applications. The plant extracts have shown pain-relieving and anti-parasitic effects in animal models. Both benzene and methanol extracts from the leaves, flowers, rhizomes, and seeds have significant central and peripheral pain-relieving effects at a dose of 50 mg/kg (Nirmal et al., 2007). Additionally, *v* has shown promise in managing inflammation and related disorders, providing health benefits due to its natural properties (Taher et al., 2024). The cytotoxic effects of *Canna indica* rhizome extracts against human liver cancer HepG2 cells and WiDr colon cancer cells suggest its potential for cancer treatment (IFANDARI et al., 2020). Researchers have also investigated its potential to lower blood sugar by studying its effects on alpha-amylase and alpha-glucosidase (Singh et al., 2016). For blood disorders, *Canna indica* has shown in vitro activity against sickling, presenting a promising path for treating sickle cell anemia (Iyekowa et al., 2023).The plant's antimicrobial properties have been a subject of research, with extracts demonstrating activity against various pathogens (Singh et al., 2016). Recent research on the green synthesis of copper nanoparticles (CuNPs) using flower extract indicates its potential as a reducing and stabilizing agent due to its high polyphenol and flavonoid content (Madhu et al., 2025). These CuNPs showed antioxidant, antimicrobial, and cytotoxicity properties, further broadening the plant's therapeutic scope (Madhu et al., 2025). The total phenolic content was reported as 193.57 ± 7.26 µg GAE/mL, and total flavonoid content as 117.13 ± 5.91 µg CE/mL in the flower extract (Madhu et al., 2025).

Conclusion

To sum up, *Canna indica* is an adaptable plant with great promise in a variety of fields. With anti-inflammatory, antinociceptive, anthelmintic, antidiabetic, and cytotoxic qualities, its rich phytochemical profile adds to its therapeutic efficacy. It is a great option for treating different types of wastewater and contaminated soils due to its strong phytoremediation properties. Furthermore, given the difficulties facing world health, thorough research is necessary to fully understand its potential as a source of antiviral medicines. To fully utilize Canna's therapeutic and environmental benefits, more study into its precise mechanisms of action, ideal extraction methods, and clinical validations will be essential.

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Biostimulants: Prospects and Challenges in Floriculture

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Abstract

Rising environmental concerns and consumer demand for eco-friendly products are driving the global floriculture industry towards sustainable production. Biostimulants, such as organic substances and beneficial microorganisms, have emerged as promising tools to enhance plant growth, nutrient-use efficiency, stress tolerance, and ornamental quality. This review synthesizes current knowledge on the role of biostimulants in floriculture and evaluates their prospects and challenges in the Nepalese context. Biostimulants, including humic substances, seaweed extracts, protein hydrolysates, and microbial inoculants, are discussed alongside their mechanisms of action. Biostimulants offer significant opportunities to expand domestic flower markets. However, challenges such as limited research, lack of standardization, and regulatory gaps hinder their widespread adoption. The paper concludes with future research directions and policy recommendations to integrate biostimulants into Nepal's floriculture industry.

Keywords: Biostimulants, Floriculture, Ornamental plants, Sustainable

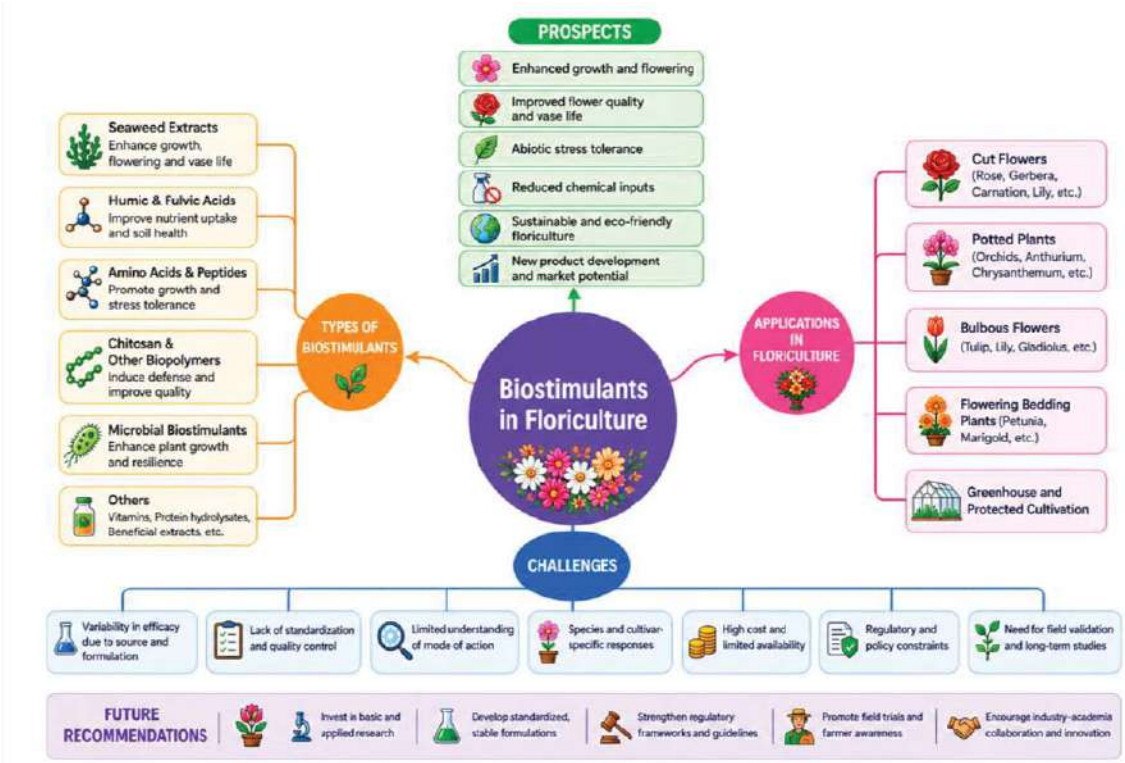

Figure: Graphical Abstract

Introduction

The floriculture industry is rapidly expanding and has a significant impact on the global economy and agribusiness. In Nepal, the sector has grown markedly in recent years, contributing to employment generation, urban landscaping, and income diversification. However, Nepalese floriculture faces challenges such as low productivity, poor quality standards, pest and disease pressures, and overreliance on chemical fertilizers and pesticides (Popp et al., 2013). Synthetic fertilizers and pesticides are widely used to enhance food supply, with severe consequences for human health, biodiversity, and the environment. Therefore, it is necessary to gradually reduce the use of such agrochemicals by developing environmentally friendly alternatives (Du Jardin, 2015). Globally, digital tools and technologies have been developed to monitor plant health, optimize resource use, and improve output efficiency. Among these, biostimulants have attracted considerable interest and have emerged as innovative inputs that enhance plant growth and productivity through natural processes. In recent years, biostimulants have gained attention as sustainable alternatives to conventional agrochemicals because they are generally considered biodegradable, non-toxic, non-polluting, and non-hazardous (Yakhin et al., 2017).

Biostimulants are small amounts of organic or inorganic matter that enhance overall plant performance and are also known as "positive growth regulators" or "metabolic enhancers". Plant biostimulants are substances or microorganisms used to promote plant growth and development. They enhance nutrient uptake, tolerance to abiotic stress, and/or overall quality attributes without altering the actual nutrient composition (Chiaiese et al., 2018). Their application in floriculture is gaining importance due to their ability to improve plant vigor, flowering, and aesthetic traits while reducing environmental impact. Biostimulants used in ornamentals include humic substances, seaweed extracts, protein hydrolysates (amino acids), microbial inoculants, and bio-based soluble substances. They commonly enhance root growth, nutrient use efficiency, flowering quality, and tolerance to abiotic stress through physiological, anatomical, and metabolic modulation. Unlike fertilizers, biostimulants do not directly supply nutrients but enhance plant physiological processes, leading to improved growth, yield, and quality. Their application in floriculture is particularly important, where visual quality traits such as flower size, color, uniformity, and vase life are critical (Parađiković et al., 2019; Kisavarga et al., 2022).

Classification of biostimulants and their role

Algae extracts

Algae extracts have long been used as a source of organic matter; however, their biostimulatory effects have been reported more recently. These algal extracts are derived largely from marine microalgae, particularly brown seaweeds such as Ascophyllum nodosum, Ecklonia maxima, and Macrocystis pyrifera, and are enriched with vitamins, phytohormones, mineral nutrients, amino acids, complex polysaccharides, osmoprotectants, and antimicrobial compounds, which are known to improve plant growth and productivity when applied as growth supplements (Khan et al., 2009; Sharma et al., 2014). The commercial application of these algal extracts has been rapidly increasing. They can be applied as a foliar spray, through soil tillage, or as a combination of both. Microalgae biostimulants confer resistance to various biotic and abiotic stresses. They suppress diseases in ornamentals and increase nutrient uptake, drought resistance, and salt tolerance. Monder et al. (2014) reported that the optimal concentration of seaweed extract increased rooting ability and

chlorophyll and protein contents in rose shoots. The Ascophyllum seaweed extract had a significant effect on stem height and diameter, as well as root dry matter content, in Chrysanthemum ssp. (da Silva et al., 2010). The microalgae extract increased the number of shoots and roots in the vegetative propagation of Robiniapseudoacacia by cuttings (Kaviani et al., 2016).

Humic acids and fulvic acids

Humic acids (HA) and fulvic acids (FA)are reported to have beneficial effects on plant growth, nutrient availability, and microbial communities (du Jardin, 2015; Canellas & Olivares, 2014). Humic substances are naturally occurring, complex organic compounds formed by the decomposition of plant and animal residues and by microorganisms such as fungi and bacteria (Stevenson, 1994; Canellas & Olivares, 2014). Humic substances enhance soil fertility, improve water retention, and facilitate plant nutrient uptake, thereby improving morphological properties and crop yield (Calvo et al., 2014; Parađiković et al., 2019). Humic acid acts as a long-term soil conditioner with a large molecular structure, whereas fulvic acid is a smaller, short-term molecule and is more active than humic acid. Humic acids work best in the soil, whereas fulvic acid is most effective in foliar application (Kisvarga et al., 2022; Parađiković et al., 2019). Thus, they help to reduce fertilizer application rates, enhance nutrient use efficiency, replace the use of plant regulators, and carry beneficial microorganisms to promote plant growth (Canellas et al., 2015).

Industrial by-products: protein hydrolysates andchitosans

Amino acids and peptides derived from plant or animal sources are protein hydrolysates, which act as biostimulants by enhancing nutrient assimilation, enzymatic activity, and plant metabolism. Application of protein hydrolysates promotes root development, chlorophyll synthesis, and flowering in ornamental plants, while improving plant tolerance to abiotic stresses by regulating osmotic balance and activating antioxidant systems (Colla et al., 2015; Rouphael & Colla, 2020). Chitosan, derived from chitin, acts as a natural elicitor that enhances plant defence mechanisms. It improves seed germination, plant growth, and resistance to pathogens such as Botrytis cinerea in ornamentals. It also enhances flower quality, prolongs vase life, and reduces post-harvest losses (Parađiković et al., 2019; Yakhin et al., 2017). Foliar application of legume-derived protein hydrolysates has been shown to significantly improve biomass and flower yield in crops such as Petunia and Geranium (Cirillo et al., 2017; Cristiano and De Lucia, 2021). Similarly, animal-based hydrolysates derived from collagen or fish waste enhance nitrogen metabolism and stimulate early flowering in roses and chrysanthemums (Chiaiese et al., 2018; Yakhin et al., 2017).

Microbial biostimulants

Microbial biostimulants include plant growth-promoting rhizobacteria (PGPR), mycorrhizal fungi, and other fungal inoculants. These microorganisms enhance nutrient uptake, improve soil health, and protect crops from phytopathogens (du Jardin, 2015; Rouphael&Colla, 2020). PGPR, such as Azospirillum, Azotobacter, and Bacillus subtilis, produce phytohormones, including auxins and cytokinins, that stimulate plant growth, while mycorrhizal fungi, such as Glomus spp., enhance root surface area and nutrient absorption. They also improve plant resistance to biotic and abiotic stresses (Backer et al., 2018; Smith & Read, 2010). Inoculation of plants with arbuscular mycorrhizal fungi has been reported to increase flower size, number, and longevity in species such as chrysanthemum and tuberose. Microbial biostimulants stimulate shoot and root growth, accelerate flowering, and increase chlorophyll content and nutrient uptake in plants, contributing to improved ornamental quality and yield (Rouphael & Colla, 2020). Foliar application of Trichoderma is reported to increase leaf size and chlorophyll content in Passiflora caerulea (Şesan et al., 2020) and to enhance abiotic

stress tolerance in Olea europea (Di Vaio et al., 2021). PGPRs can play a significant role in the growth and flowering of the annual ornamental Petuniahybrida (Hoda and Mona, 2014) and enhance the efficiency of Cattleya guttata cultivation (Manhães et al., 2015). Furthermore, PGPRs affect morphological parameters and essential oil content in Ocimumbasilicum (Ordookhani et al., 2011), increase tolerance of Camellia japonica to salt stress (Park et al., 2017), promote root formation in Ficus benjamina (Sezen et al., 2014), and enhance the colour intensity of the upper leaves of Euphorbia pulcherrima (Karagoz and Dursun, 2020).

Mechanism of action of biostimulants

Biostimulants influence plant growth and development through complex physiological, biochemical, and molecular processes. They do not directly supply nutrients but enhance plant performance by stimulating natural processes such as nutrient uptake, metabolism, and stress tolerance (du Jardin, 2015). Biostimulants act on plants and plant processes through various mechanisms, such as:

1. Enhancement of nutrientuse efficiency

The primary mechanisms of biostimulants are the improvement of nutrient uptake and nutrient use efficiency (NUE) in plants. Biostimulants stimulate root growth and increase root surface area, enhancing the plant's ability to absorb water and nutrients from the soil. Humic substances improve soil structure and cation exchange capacity, facilitating the mobility of nutrients such as nitrogen, phosphorus, and potassium (Canellas & Olivares, 2014; Kisvarga et al., 2022). Similarly, microbial biostimulants such as plant growth-promoting rhizobacteria (PGPR) enhance nutrient acquisition through nitrogen fixation and phosphate solubilization (Rouphael & Colla, 2020). Protein hydrolysates and amino acids act as signaling molecules that regulate nitrogen metabolism and enzyme activities involved in nutrient assimilation (Colla et al., 2015). In greenhouse floricultural crops, nutrientuse efficiency and biomass accumulation are enhanced by microbial biostimulants (Lin and Jones, 2022).

2. Modulation of root architecture

Biostimulants promote root elongation by stimulating lateral root formation and root hair development. These changes increase root surface area and enhance water and nutrient uptake, thereby shaping root system architecture (Calvo et al., 2014). Seaweed extracts contain natural plant growwth regulators, including auxins and cytokinins, which stimulate root growth and differentiation (Chiaiese et al., 2018). Enhanced root architecture enables plants to explore a larger soil volume, increasing resilience under nutrient-deficient and drought conditions (Rouphael & Colla, 2020). Humic acids can activate root plasma membrane H^+-ATPase activity, thereby promoting root growth (Canellas & Olivares, 2014). Application of Ascophyllum nodosum extract increased root biomass and root branching in ornamental crops such as petunia and geranium (Sharma et al., 2014; Cirillo et al., 2017).

3. Phytohormone activityregulation

Biostimulants regulate endogenous phytohormone levels and signaling pathways, thereby influencing plant growth and development. Inoculation with Bacillus subtilis increased endogenous auxin levels and improved growth in plants such as chrysanthemum (Parađiković et al., 2019). Biostimulants either contain hormone-like substances or stimulate plants to produce their own hormones. Seaweed extracts contain auxins, cytokinins, and gibberellins, which promote cell division, elongation, and differentiation (Chiaiese et al., 2018). PGPR can synthesise hormones such as indole-3-acetic acid (IAA), which enhance root growth and overall plant vigour (Rouphael & Colla, 2020).

4. Enhancement of variousmetabolic activities

Seaweed extracts and protein hydrolysates enhance chlorophyll synthesis and photosystem efficiency, leading to higher photosynthetic rates (Kisvarga et al., 2022). They also stimulate key metabolic enzymes involved in respiration and energy production, resulting in increased plant growth and productivity. Seaweed extracts increase the efficiency of Photosystem II and chlorophyll content in ornamental species (Sharma et al., 2014). Protein hydrolysates improve carbon and nitrogen metabolism, thereby enhancing plant growth (Colla et al., 2015). Thus, biostimulants improve photosynthetic efficiency by increasing chlorophyll content, enhancing enzyme activity, and improving carbon assimilation, resulting in improved metabolic activity and biomass accumulation, which enhance ornamental quality traits such as flower size and color (Parađiković et al., 2019).

5. Induction of defensemechanism

Under stress conditions, plants produce reactive oxygen species (ROS), which can damage cellular components. Thus, biostimulants play a crucial role in mitigating oxidative stress by enhancing the plant's antioxidant defence systems (Rouphael & Colla, 2020). They stimulate the production of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD), which neutralise ROS (Kisvarga et al., 2022). Protein hydrolysates and microbial biostimulants have been shown to increase antioxidant activity, thereby protecting plants from oxidative damage.

6. Abiotic stress tolerance in plants

Biostimulants enhance plant tolerance to abiotic stresses, including drought, salinity, temperature extremes, and heavy metal toxicity. They regulate osmotic balance by promoting the accumulation of osmotic protectants such as proline, sugars, and glycine betaine (Rouphael & Colla, 2020). They also improve water use efficiency and maintain cellular integrity under stress. For example, seaweed extracts enhance drought tolerance by improving stomatal regulation and water retention, while humic substances reduce heavy metal toxicity by chelating harmful ions (Parađiković et al., 2019). Microbial biostimulants improve salinity tolerance by enhancing ion balance and water uptake (Lin & Jones, 2022).

7. Tolerance and resistance in plants

Biostimulants, particularly microbial inoculants and chitosan, enhance plant immunity by inducing systemic resistance mechanisms. Chitosan acts as an elicitor, triggering defense responses such as the production of phytoalexins and pathogenesis-related proteins (Chiaiese et al., 2018). Similarly, PGPR induce systemic resistance by activating plant defense signaling pathways, thereby increasing resistance to pathogens (Backer et al., 2018). Introduction of Trichoderma spp. reduces disease incidence caused by Botrytis cinerea in ornamental plants while promoting plant growth (Şesan et al., 2020).

8. Molecular and genetic regulation

Some studies indicate that biostimulants influence gene expression related to growth, metabolism, and stress response. They regulate genes involved in nutrient transport, hormone biosynthesis, and antioxidant activity. For instance, protein hydrolysates can upregulate genes associated with nitrogen metabolism and stress tolerance (Colla et al., 2015). Microbial biostimulants can modulate gene expression related to stress signaling and defense pathways (Backer et al., 2018). Microbial biostimulants can also alter gene expression related to nutrient uptake and stress tolerance, improving overall plant performance (Lin and Jones, 2022). This molecular regulation enhances plant adaptability and performance under varying environmental conditions.

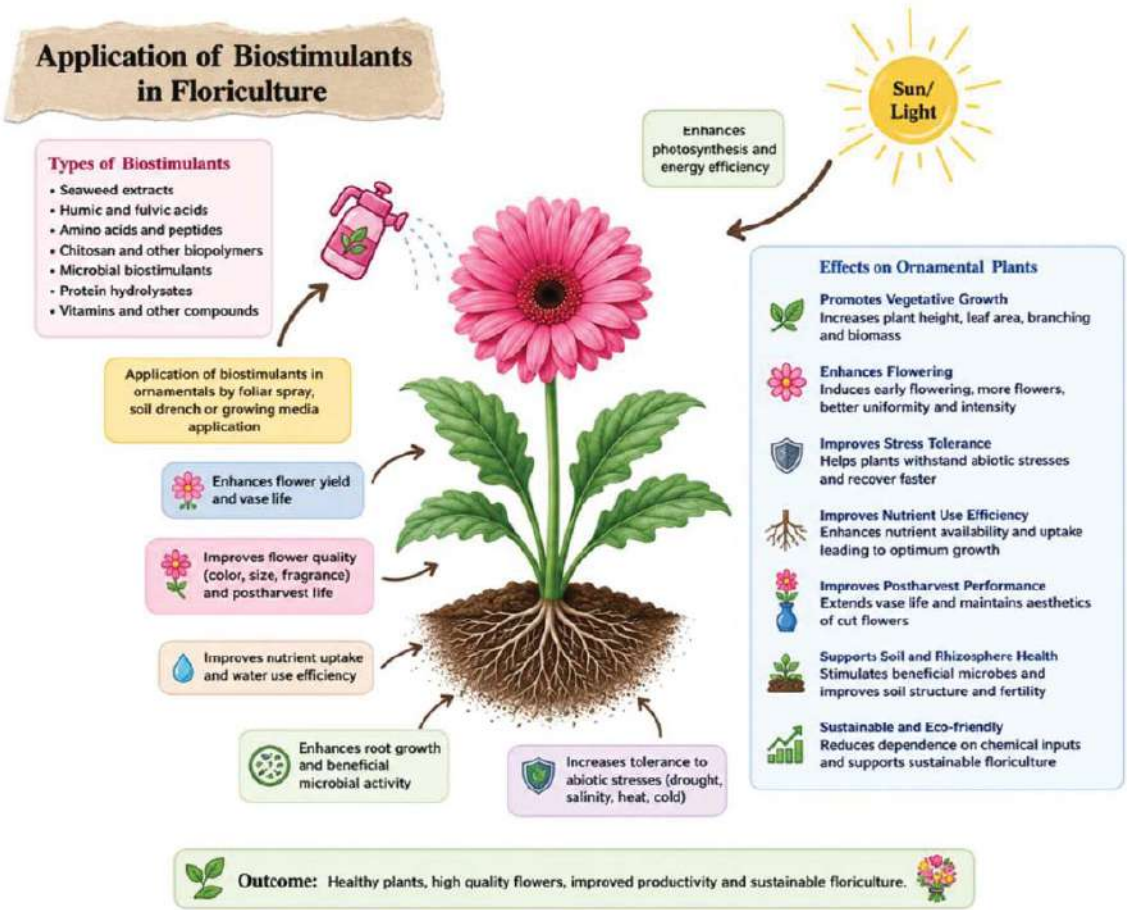

Figure 1: Application of biostimulants in floriculture

Prospects of biostimulants in floriculture

As floriculture is an emerging sector, biostimulants can improve production, productivity, and quality while enhancing sustainability and eco-friendly production practices. Various prospects, as mentioned, have created a significant likelihood of biostimulants in floriculture sector.

1. The use of biostimulants aligns closely with agricultural sustainability because they are biodegradable, non-toxic, and environmentally friendly, reducing reliance on synthetic and chemical fertilizers and pesticides. In the current context, the increasing and indiscriminate use of agrochemicals poses risks to soil health and biodiversity. Thus, biostimulants offer an eco-friendly alternative to maintain productivity and minimize environmental degradation (Yakhin et al., 2017).

2. Various qualitativetraits, such as flower size, color, fragrance, and vase life, determine the market value of ornamental plants. Biostimulants enhance quality parameters by improving physiological and biochemical processes in plants. The application of seaweed extracts, humic substances, and protein hydrolysates has been shown to improve flower colour uniformity and longevity, thereby increasing their commercial value (Rouphael and Colla, 2020).

3. As Nepal is highly vulnerable to climate change, various environmental stresses adversely affect ornamental crop productivity and quality. Biostimulants can enhance antioxidant activity, osmotic regulation, and water use efficiency, thereby improving plant tolerance and resilience (Kisvarga et al., 2022).
4. Indigenous resources, such as compost, vermin compost, plant extracts, and locally available microbial inoculants, can be developed into low-cost biostimulants, reducing dependence on imported products and promoting sustainable resource use (Chiaiese et al., 2018).
5. Increased demand for organic and chemical-free ornamental products in both domestic and international markets indicates a compatible scope and potential for the use of biostimulants (du Jardin, 2015).
6. In Nepal, the growing trend towards protected cultivation, especially for high-value flowers such as gerbera, carnation, and rose, highlights the effectiveness of biostimulants, which can optimise plant growth, improve nutrient efficiency, and enhance flower quality (Yakhin et al., 2017; Rouphael and Colla, 2020).
7. Humic substances and microbial inoculants enhance soil organic matter and biological activity, both essential for sustainable production (Kisvarga et al., 2022). Thus, biostimulants can improve soil structure, microbial activity, and nutrient cycling, thereby contributing to long-term soil fertility.
8. Integrating biostimulants with fertilizers and organic amendments can reduce fertilizer requirements, lower production costs, and minimize environmental pollution, making floriculture more economical and environmentally sustainable (du Jardin, 2015; Rouphael and Colla, 2020).
9. The field of biostimulants offers significant scope for research and innovation in Nepal. Developing crop-specific formulations, exploring indigenous microbial strains, and standardizing the application and evaluation of biostimulants under diverse agro-climatic conditions help improve their use for crop improvement.

Challenges of biostimulants in floriculture

Although biostimulants offer significant benefits for sustainable floriculture, their adoption in Nepal is constrained by technical, economic, and institutional challenges.

1. Limited awareness and technical knowledge

Many florists in Nepal still rely on conventional agrochemicals due to familiarity and the immediate, visible effects. Inadequate extension services and limited training for farmers further restrict the dissemination of knowledge about biostimulants and their scientific use. Nepal also has abundant organic and biological resources (e.g., compost, vermin compost, plant extracts, beneficial microbes) with potential as biostimulants, yet they remain largely unidentified and underexplored. In addition, biostimulants often require precise timing, application methods, and integration with nutrient management practices. Lack of compatibility or inappropriate integration can reduce their effectiveness (Kisvarga et al., 2022).

2. Limited exploration and research

Exploration, innovation, and research from indigenous sources are lacking in the local context. The lack of location-specific studies to evaluate the effectiveness of various biostimulants has limited scientific recommendations and policy formulation, as effectiveness is influenced by factors such as

plant species, soil type, environmental conditions, and application methods. Nepal's diverse agro-climatic conditions, ranging from the Terai to the high hills region, also make predicting outcomes difficult. This inconsistency is a major barrier to large-scale adoption (Kisvarga et al., 2022). This research gap highlights the need for adaptive research and field validation, creating the scope of the study.

3. High cost and adoption barriers

The development, production, and application of biostimulants are limited by the scarcity of infrastructure, including skilled technical expertise, laboratories, processing units, and quality testing facilities. Commercial biostimulant products are often expensive and inaccessible to small-scale farmers. High costs discourage adoption, particularly in resource-limited farming systems. The lack of certification systems and premium pricing for eco-friendly flowers also discourages growers from investing in alternative inputs (Yakhin et al., 2017).

4. Regulatory and policy gaps

The regulatory framework for biostimulants is still evolving globally, and in Nepal, it remains largely undefined. Most regulatory bodies often define biostimulants alongside fertilizers or pesticides, leading to confusion in classification, registration, and approval processes. The absence of clear guidelines for product registration, quality standards, and labeling creates challenges for both producers and users (Du Jardin, 2015). Thus, further study, exploration, research, and innovation should be pursued through national and international policies to ensure sustainable use.

Future research recommendations

Although biostimulants have shown significant potential in floriculture, knowledge gaps and limited research have hindered the accumulation of scientific evidence, impeded efforts to improve product efficacy, and slowed large-scale adoption in floriculture systems. Thus, future research on biostimulants should adopt a multidisciplinary approach that integrates diverse aspects and emphasizes localized research and innovation. Location- and crop-specific formulations, validated in the field under Nepal's diverse agro-climatic conditions, can improve the efficacy and use of biostimulants for farmers. Developing standardized guidelines for optimal dosage, application methods, and plant growth stages can ensure consistent performance. Nepal also has locally available resources, such as plant extracts, composts, vermi-compost, and microbial strains that can be developed into low-cost biostimulants through proper isolation and characterization. Further study of the mechanisms of action of various biostimulants and their integration into farming systems to harness their ability to support plant defense can help optimize resource-use efficiency and sustainability. In addition, cost-benefit analyses are necessary to support the appropriate use of biostimulants by small-scale farmers.

Conclusion

In the context of Nepalese floriculture, biostimulants offer strong prospects for developing a sustainable, climate-resilient, and financially successful agricultural sector. Their compatibility with organic farming methods and potential use of local resources make them well suited to Nepal's diverse agro-climatic settings. Furthermore, their capacity to improve floral quality traits enhances market competitiveness both domestically and globally. However, the broad use of biostimulants in Nepal is hampered by several obstacles, including limited farmer knowledge, a lack of standardized formulations, insufficient research under local conditions, and the absence of a defined regulatory framework. Thus, with the right research support, awareness campaigns, and legislative frameworks, biostimulants can play a critical role in advancing ecologically responsible floriculture in Nepal.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that ChatGPT was used to generate the figure while writing this manuscript.

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Care and Management of Indoor Plants

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Abstract

Rapid urbanization has reduced open green spaces, making indoor plants a popular alternative for maintaining a connection to nature in Nepal's urban areas. Beyond decoration, these plants provide significant environmental and psychological benefits, such as reducing CO_2 levels, purifying indoor air, and enhancing emotional well-being. Popular species in Nepal include peace lily, money plant, lucky bamboo, snake plant, jade plant, spider plant, and anthurium. However, successful cultivation in urban environments faces challenges such as limited sunlight and improper watering. This article outlines essential care and management strategies, including optimal potting mixtures, light and temperature regulation, nutrient management, and pest control, to ensure the longevity and health of indoor greenery.

Keywords: Indoor plants, Care and management, Potting media, Environmental quality

Introduction

Plants grown in the indoor environment of a house, such as the kitchen, living room, bedrooms, and passages, are called indoor plants (Shrestha, 2022). In other words, living organisms in human spaces that create a connection to nature are called indoor plants (Bringslimark et al., 2009). These are ornamental and foliage plants grown mainly for decorative, environmental, and psychological benefits. Planting indoor plants can reduce CO_2 levels through photosynthesis and serve as small carbon sinks, thereby improving indoor air quality. The presence of plants also enhances occupants' comfort, emotional well-being, and work performance, creating a refreshing indoor environment. Thus, integrating indoor plants into buildings can support better indoor environmental quality, improved human well-being, and sustainable building design (Budaniya et al., 2025; Chang et al., 2025).

Historical studies show that people began growing indoor plants about 2,000 years ago. In ancient Greece and Rome, citizens grew plants in pots indoors and in courtyards around 500 BC. Plants such as cacti, palms, and ferns became popular in North America and England in the 19th century. In American society, indoor plants gained importance only after World War II, as houses and buildings featured larger windows, bigger rooms, courtyards, and verandas. By making rooms brighter and using fluorescent lights, suitable environments were created for plants to grow indoors (Shrestha, 2022).

In Nepal, with the increased urbanization and population density, open spaces for gardening are gradually diminishing. As a result, indoor gardening has become increasingly popular among urban households. People living in apartments, rented houses, and small residential spaces are adopting indoor plants as an alternative way to maintain greenery and connect with nature. In urban areas such as Kathmandu, Pokhara, Chitwan, and Lalitpur, demand for indoor plants has increased significantly in recent years. Plants such as Peace lily, Spider plant, Snake plant, Chinese evergreen, ZZ plant, Pothos/Money plant, Fiddle Leaf Fig, Boston Fern, Dragon tree, Rubber plant, Jade plant, etc., are among the popular indoor plants in Nepal (Online Khabar, 2021; Flowers in Nepal, 2023).

Factors such as light availability, watering practices, temperature, humidity, potting media, nutrition application, and pest management are crucial to maintaining healthy indoor plants. However, in Nepal's urban environments, challenges such as limited sunlight, poor ventilation, irregular watering, and a lack of technical knowledge can hinder plant growth and survival. Therefore, understanding appropriate care and management practices for indoor plants is essential to sustaining healthy growth in households. Proper selection of plant species, suitable potting mixtures, adequate watering, fertilization, and pest control can greatly improve the longevity and aesthetic value of indoor plants

Frequently used plants for indoor planting

1. Money plant/Pothos (Epipremnumaureum, Araceae)

The money plant is a valuable, multipurpose plant with medicinal, pharmacological, and environmental benefit. It is a monocotyledonous flowering plant with flowers arranged in an inflorescence called a spadix. Leaves are evergreen and waxy, heart-shaped, alternate, and simple, or variegated with various shades of green and other colors. The plant produces trailing stems when it climbs trees or grows up to 20 m, and these strike roots when they reach the ground (Meshram & Shrivastava, 2015). It shows stable growth in low-light environments (approximately 540 to 1,076 lux) and with infrequent watering. It can be rapidly multiplied by cutting, enhancing its aesthetic qualities (Chen & Henny, 2025). It acts as a botanical biofilter that effectively removes indoor volatile organic compounds, with its leaf surface and root-associated microbes working together to enhance air purification, making it a sustainable solution for healthy indoor environments (Montaluisa et al., 2025).



2. Lucky bamboo (Dracaena sanderiana, Asparagaceae)

Lucky bamboo is a xerophytic plant within the monocot clade, popular as an indoor plant in Nepal. Its leaves are bright green or grey-green, spaced widely along the upright stem, contributing to an open, airy appearance, and branches are succulent (Anuruddi & Fonseka, 2022; Kavitha et al., 2024). As a versatile plant, it thrives in diverse environments and can be easily grown in both soil and water, making it a popular choice for indoor gardening. It also purifies air by removing harmful substances such as benzene. It is famous for its adaptability, requiring bright and indirect sunlight (40 to 100 µmol/m^2/s), making it an easy-to-care-for plant (Kavitha et al., 2024). It is a popular cut-foliage crop with various therapeutic, antioxidant, and air-purifying properties (Anuruddi & Fonseka, 2022).



3. ***Snake plant*** *(Sansevieria trifasciata, Asparagaceae)*



The snake plant is a perennial xerophyte popular as an ornamental, with long rhizomes and fibrous roots (Rajasekhara, 2024). It has long, upright, thick, sword-shaped leaves and follows Crassulacean acid metabolism (CAM), which is beneficial for indoor air purification (Nigam et al., 2025). It is a highly adaptable ornamental plant known for antimicrobial, antidiabetic, anticancer, and antioxidant properties (Rajashekara, 2024). The plant is highly resilient to climate change and exhibits high morphological diversity. It thrives in low-water, high-temperature conditions and can be propagated by cutting and rhizomes (Nigam et al., 2025). However, it can grow well both indoors and in gardens and can survive for up to 20 years (Shrestha, 2022).

4. ***Peace lily*** *(Spathiphyllumspp., Liliaceae)*



The peace lily is a perennial, flowering, evergreen, monocot plant native to tropical regions of America and Southeast Asia (Safeena et al., 2023). It is popular as an ornamental indoor plant because it grows in shaded areas (1,000–2,500 foot-candles) with minimal watering and fertilization (Shrestha, 2022). The plant has a fibrous root system, simple, glossy, dark green leaves, and a characteristic spathe inflorescence. It reduces indoor formaldehyde concentration, contributing to air purity (Safeenaet al., 2023). A plant can be propagated by stem cutting and thrives in low-light conditions (Sharma, 2022).

5. ***Jade plant*** *(Crassula ovata, Crassulaceae)*



The Jade plant is a highly valued ornamental succulent, known for its distinctive appearance and versatility. The stems are thick, branched, fleshy, and juicy, and the plant grows to a height of 30-45 cm (Tote et al., 2022). It has thick, meaty, oval-shaped, vivid green leaves with a crimson margin, forming a tree-like structure (Kumar et al., 2025). It can be easily propagated from stem cuttings with appropriate treatment and is valued for its hardiness and evergreen status (Tota et al., 2022). The Jade plant is known for its anti-inflammatory, antibacterial, and antioxidant properties, attributed to bioactive substances such as flavonoids, terpenoids, and phenolics (Kumar et al., 2025).

6. Spider plant (Chlorophytum comosum, Liliaceae)



The spider plant is an evergreen, perennial, flowering plant native to tropical and southern Africa (Dyduch-Siemińska et al., 2023). It is popular as a houseplant for its resilience, but fluoride in tap water can affect its growth. The spider plant prefers bright, indirect light, moderate watering, and a wide range of soil conditions. It forms clumps with arching leaves and produces stolons bearing plantlets. Leaves are simple, variegated, and stemless. It can be propagated by seed and by potting plantlets obtained by dividing the main plant (Gilman, 1999). The methanolic extract of the leaves contains valuable bioactive constituents, and the plant is useful for air purification in indoor environments (Rzhepakovsky et al., 2022).

7. Anthurium (Anthurium andraeanum, Araceae)



Anthurium is a high-value flowering indoor plant popular for its bright, attractive flowers and glossy foliage. It thrives in warm, humid, shaded environments, with an optimum temperature of 18-27˚C (Zotz et al., 2020). Anthurium is popular for its colorful spathes in red, white, pink, and orange, and for long-lasting blooms that can last for about 2 months, making it popular in urban households and interiors. It requires proper irrigation and a phosphorus-containing fertilizer for better establishment (Sharma, 2022). It is propagated by seed, division, or cutting, and rooting is best in a well-aerated potting mixture (Chen et al., 2003). Thus, its color, texture, shape, and spathe showiness, along with low maintenance needs, make it a popular option for indoor planting.

8. Orchid (Phalaenopsis spp., Orchidaceae)

Phalaenopsis is one of the most popular flowering orchids for indoor cultivation, as it is well adapted to home conditions. It is popular for its large, diverse flowers in various colours, such as pink, red, purple, green, yellow, and orange (Hsu et al., 2018). It is an epiphytic plant that requires bark, moss, or special media under warm, shaded conditions for successful cultivation. It can tolerate temperatures of 32-35˚C but should not be exposed to temperatures below 10˚C to avoid chilling injury. Scientific cultivation practices ensure synchronized flowering and plant health in indoor systems. It requires optimal watering, as it is sensitive to overwatering, and a moist environment with a smaller-particle-sized potting mixture to promote proper air circulation (Wang et al., 2007). Growing media have a highly significant influence on the plant's



nutritional status, and the leaves and substrate roots of the orchid show varied accumulation of microelements and macronutrients; thus, careful fertilizer management is a must (Trelka et al., 2010). Hence, orchids are successful and emerging indoor plants, popular everywhere.

Soil and potting mixture

It is essential to consider the soil and potting mixture for the healthy growth of indoor plants. As indoor plants depend entirely on the growing media provided, appropriate selection and management are critical to ensure proper aeration, nutrient uptake, and root growth. A well-drained, lightweight, pathogen-free soil, rich in organic matter, is ideal for the proper growth of indoor plants. Some common and effective potting mixtures used for indoor planting are listed in Table 1.

Table 1. Growing media for Indoor Plants

Media mix	Ratio	Uses
Loamy soil, Compost + Leaf litter, and Sand/Perlite	2:1:1	Common growing media
Loamy soil, Sand and Peatmoss/Leaf litter	1:1:1	Common growing media
Loamy soil, Peatmoss/Leaf litter and Sand/Perlite	1:1:1	Plant requiring high organic matter
Loamy soil, Compost/Leaf litter, Sand/Perlite and Gravel	2:2:2:1	Plants like cactus and succulents
Leaf litter/sawdust, Sand/Perlite and Gravel	4:2:1	For orchids
Add 1% bonemeal to all the prepared mixture		

Source: Shrestha, 2022

Care and management of indoor plants

The care and management of indoor plants is a regular, intensive process aimed at transforming enclosed indoor spaces into living environments. It involves daily practices such as observing plants, understanding plant needs, watering, fertilization, pest control, and repotting. Caring practices are ongoing and learned over time, as they are challenging and dynamic across plant types. They differ according to the acclimatization and adaptation of plants to the provided environment (Philips & Schulz, 2021). The common management practices associated with indoor planting are:

1. Temperature and humidity

Most indoor plants are flexible and adapted to a wide range of temperatures, as they grow in an environment adjusted to the temperature range for human comfort. The optimum temperature range for indoor plants during the day is between 15-21˚C, with night temperatures above 10˚C. Within this optimum range, plants can carry out physiological functions effectively, which aids in proper establishment. Plants also prefer high humidity, which can be maintained by adding damp sphagnum moss packed between pots in planters and by placing the pot on a shallow tray of moist gravel. However, very high or very low temperatures combined with low relative humidity are undesirable for plant growth and survival, leading to heat stress and cold injury. These fluctuations are common with the use of heaters, air conditioners, and similar devices and can shorten the lifespan of indoor plants (Shrestha, 2022; Pinyuh et al., 2024).

2. Light management

Indoor plants often require careful adjustment of light intensity to flourish indoors. When light levels are too low, growth slows, stems weaken, and leaves lose their color. Conversely, excessive sunlight exposure increases the risk of leaf burn and stress. Light intensity can be increased by moving plants closer to windows, placing them in brighter rooms, or supplementing with artificial lights. It can be decreased by hanging lace curtains, minimizing reflected light. For artificial lighting, fluorescent tubes can be used as required or LED lights with various colours can be used as per the requirement (floral induction with blue or green LED lights) (Shrestha, 2022; Pinyuh et al., 2024).

3. Water management

Water requirements for plants are non-uniform and vary with the type of plant grown and the prevailing weather conditions. Succulents and cacti, which are naturally adapted to arid conditions, require relatively little water, whereas high temperatures and hot weather conditions demand more water. However, most plants should be watered when the soil feels somewhat dry. Apply enough water to thoroughly saturate the potting mixture, ensuring that moisture reaches the root zone. An effective method for watering indoor plants is to fill the saucer with water and let it be absorbed by plant roots in the container. Regular monitoring is essential to assess the water required by the plant, based on soil moisture and plant appearance (Niemiera, 2018; Shrestha, 2022).

4. Nutrient management

Indoor plants are grown in containers and have only a limited amount of soil to draw nutrients from, so fertilizers must be replenished regularly to sustain plant growth. Soluble fertilizers are applied by dissolving them in water, and slow-release fertilizers are applied by following label directions and preparing only enough solution for each application. Granules of slow-release fertilizers are also applied directly near the root zones, allowing the requisite quantity of nutrients to the plants at every application of water. These slow-release fertilizers can last for 3, 6, 12, or 18 months. Similarly, during the active growing season, fertilize the plant with regular fertilizer every two weeks, while in the dormant season, applications should be reduced to every four to six weeks, or withheld entirely if plants are not growing. Avoid over-fertilization and under-fertilization, as excess nutrients can damage or kill plants, and minimal application halts plant growth. Regular monitoring of plant growth and soil condition ensures proper nutrient management and healthy container plants (Pinyuh et al., 2024; Niemiera, 2018; Shrestha, 2022).

5. Repotting

Indoor plants should be repotted periodically, depending on their growth rate, typically when the roots fill the pot and emerge from the drainage holes. Small, fast-growing plants may require repotting every 3-6 months, while mature plants are usually repotted every 1-3 years or when they become root-bound. During repotting, the plant should be carefully removed by inverting the container and holding the main stem securely. If the roots are tightly bound, they should be trimmed, and any salt-accumulated topsoil should be removed. A new pot about one-third larger than the old should be used, with fresh potting mix added at the base to position the root ball slightly below the rim. The plant is centered, soil is filled around the sides, gently firmed, and watered to allow settling, leaving space at the top for irrigation. Proper handling and consideration of plant size, container type, and soil mixture are essential to avoid damage and ensure healthy growth (Pinyuh et al., 2024; Niemiera, 2018).

6. Integrated plant health management

Indoor plants can be affected by several biotic and abiotic factors, similar to those affecting outdoor plants. Common pests include aphids, mealybugs, scales, spider mites, thrips, and whiteflies, while major diseases include damping-off, powdery mildew, nematodes, and viral infections (Shrestha, 2022). In addition, physiological stresses such as fluctuations in temperature and humidity, along with unbalanced irrigation and fertilization, increase plant susceptibility. Thus, integrated plant health management can ensure proper plant vigor, reduce infection and infestation, and improve sustainability and plant establishment. Preventive measures should be prioritized for indoor plants, as they are kept in living conditions and often come into contact with children and pets. New plants should be carefully inspected before being brought indoors to prevent the introduction of pests or diseases. Using sterilized soil in pots helps reduce soil-borne diseases such as root rot and nematode infestation. Environmental conditions also influence pest and disease outbreaks; for example, dry air can increase mite infestations, while excessive watering can promote fungal diseases. Major symptoms in indoor plants, prevailing conditions, and associated corrective actions are illustrated in Table 2. Thus, maintaining proper hygiene, balanced nutrition, watering, and suitable growing conditions are key components of effective and integrated management of indoor plants.

Table 2. Major problems in indoor plants

Symptoms	Causes	Corrective action
Plants have slender stems that grow unnaturally long, and their leaves are small, colorless, and prone to falling off.	Low light intensity	Place plant closer to windows and light source. Don't fertilize dormant plants.
Curling of older leaves with narrow new leaves. Leaf margins turn brown.	High light intensity	Plant should be placed away from bright lighting or use curtains in room.
Upper leaves show yellow, brown or bleached spots	Sun scorch	Provide shade area and acclimatize the plant slowly.
Leaves turn yellow, curl downward, or wilt.	High temperature	Move the plant to cool areas and avoid hot air outlets around plant.
Plants wilt in optimum soil moisture, with burning of margins and leaf tips and crusting on leaf edges in dry soil	Salt accumulation in soil	Wash out the salt by watering 3 times in 30 minutes interval.
Crust on sides of pot with dying leaves touching the rim	Salt accumulation on pot	Repotting and leaching soil by watering 3 times at 30-minute intervals.
Leaves show yellow/white spots on hairy-leaved plants.	Leaves/soil with cold water	Watering plants with water of normal room temperature.
Leaf margin shows dark brown spots.	Incomplete burned gas in room	Check for leaks and fittings of gas and burners.

Wilt plants between watering, with high root growth and slow plant growth.	Small pot	Repotting of plant in bigger pots.
Wilting and shedding of foliage in cold weather.	Chilling injury	Maintain optimum temperature range.
Potting/Repotting leads to plant loss and wilting	Transplant shock	Acclimatization of plant before repotting.
Brown leaf tips, wilting of leaves, yellowing and falling of lower leaves.	Drought/ less watering	Optimum care and management of the plant.
Curling and wilting of lower leaves. Rooting and mushy stems.	Low humidity	Increased humidity by using a bed of moist gravel or a humidifier in room.
High foliage numbers in crops with rapid plant growth.	High fertilization	Use less dose of fertilizer and avoid fertilizer use in dormant plants.
Fade in color and the dropping of foliage and smaller new leaves.	Less fertilization	Regular fertilization of plants with soluble fertilizers.
Leaf shows brown/black spots with burning tip and margin.	Fluoride in water	Use of distilled/rainwater.

Source: Pinyuh et al. (2024)

Prospects of indoor plants in Nepal

Nepal is rich in biodiversity, with a wide range of flora and fauna that create diverse ecological niches. However, increasing urbanization and lifestyle changes in Nepal have limited outdoor gardening spaces in urban areas, such as the Kathmandu Valley, making it difficult to connect with nature and greenery. In this context, indoor gardening has emerged as an effective way to reconnect with nature in urban residents' homes and professional spaces (Flowers in Nepal, 2023). Indoor plants have significant potential to improve indoor air quality through air purification. This also contributes to people's mental well-being and enhances the aesthetics of indoor environments. With the establishment of the Floriculture Association Nepal in 1992, various activities, such as technical support services, enhancement of the export potential of flower crops, and monitoring of commercial activities in floriculture, have been promoted, creating opportunities to enhance indoor plant production and promotion. In addition, opportunities include nursery establishment, plant propagation, gardening and landscaping services, input supply industries, digital marketing, and market management in indoor plantations (Thapa and Dhimal, 2017). In Nepal, this commodity is very cruicial to plant rental service providers. They supply large number of indoor plants to the corporare sectors and rotate the indoor plants every few months while holding them in a holding facility where the off duty plants are nurtured, fed with nutrients and made healthy. Thus, indoor gardening in Nepal has strong potential to enhance the urban living environment by generating market demand and sustainably developing floriculture and indoor plantations.

Conclusion

Indoor plants play a significant role in enhancing urban living environments by improving indoor air quality, aesthetic appeal, and psychological well-being. With the rapid urbanization of Nepal, where space for outdoor gardening is limited, indoor plants offer an effective way to maintain a connection with nature. However, their successful growth and sustainability largely depend on proper care and management. Key factors such as light, temperature, humidity, watering, nutrient supply, and potting media must be carefully managed to meet plant requirements. Regular practices such as repotting and

preventive pest and disease management can ensure healthy plant development. Therefore, adopting scientific, well-informed management practices is essential to maximize the benefits of indoor plants and promote sustainable urban greenery.

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Vertical Gardening: A Sustainable Approach for Urban Floriculture in Nepal

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Abstract

Vertical gardening is a sustainable, space-efficient practice of systematically growing ornamental plants on vertical surfaces, such as building walls, facades, and balconies. Rapid urbanization is continuously reducing the available agricultural land for floriculture in Nepal, creating an immediate need for innovative, land-conserving strategies in urban areas. This review explores the types of vertical gardening systems, including green facades, living walls, modular panel systems, hydroponics, and aeroponics, along with suitable plant species for vertical gardening, the benefits of these systems, and the opportunities and challenges of vertical gardening in Nepal. It offers numerous environmental benefits, including mitigating the urban heat island (UHI), improving air quality, and enhancing aesthetic and psychological well-being in urban settings. In Nepal, vertical gardening has significant potential for year-round flower production, reducing import dependence, leveraging endemic botanical diversity, and integrating smart cultivation technologies to optimize the production of floricultural products. Despite these opportunities, formal adoption is constrained by high installation and maintenance costs, structural limitations of building stocks in urban areas, water scarcity, and a shortage of technical expertise and dedicated policies. Government and institutional investment, coordinated policy reform, and targeted capacity building are essential to realize the full potential of vertical gardening and establish it as a sustainable approach to urban floriculture.

Keywords: Facades, green wall, urban floriculture, urban heat island, vertical gardening

Introduction

Floriculture is the science and art of cultivating flowering and ornamental plants, which have aesthetic and therapeutic value and contribute to human welfare and environmental quality (Manoj et al., 2025). Burud et al. (2023) stated that floriculture, or flower farming, is the study of growing and marketing flowers and foliage plants, including the cultivation of flowering and ornamental plants for direct sale or as raw materials in the cosmetics, perfume, and pharmaceutical sectors. The floriculture sector has grown steadily over the last three decades in Nepal, with commercial flower cultivation spreading across 52 districts, covering 270 hectares of land and involving more than 1,225 entrepreneurs. The annual growth rate of floriculture business volume was 10-15%, while production grew by 7-9%, indicating increased consumer demand and investment in the floriculture industry before COVID-19 (FAN, 2025). Among the major districts for the floriculture business, Kathmandu district ranks at the top for commercial flower production (>300 farmers) and serves as the epicenter of the floriculture industry's growth in Nepal.

Vertical gardening is an innovative horticultural practice of growing various plants on vertical surfaces, in contrast to traditional horizontal ground planting, and can be built using different systems, including living walls, trellises, and stacked planters(Yadav et al., 2024). As mentioned byIngole et al. (2025), the major concept of vertical gardening, it relies on the principle of maximizing the limited space while obtaining ecological benefits by utilizing walls, fences, and

other vertical structures to create a luxuriant, green environment that supports plant growth and biodiversity. Urban floriculture involves cultivating flowers and ornamental plants in urban areas, and vertical gardening aligns perfectly with its principles. Pathania et al. (2023) documented that it originated long ago, dating back to the Babylonian Hanging Gardens, and is particularly suited for vertical spaces in arid-climate cities and regions. The same article also noted that this technique increases the productive area available to growers without additional ground space by using the vertical surfaces of buildings, walls, balconies, and urban infrastructure. Jain & Janakiram (2016) mentioned that the vertical gardening is also known as green walls, living or bio walls. This kind of landscaping in urban areas receives particular attention because of its optimal combination of functional (small area and low water requirements), ecological (the ability of structures to provide wind protection and improve air quality), and aesthetic properties (Chernova et al., 2020). Advanced technologies such as the Internet of Things (IoT) have emerged, which can optimize the environment for plants by gathering data on temperature, light intensity, humidity levels & plant growth, and also utilize the data to adjust variables such as nutrient and water distribution (Halgamuge et al., 2021).

Urbanization is expanding worldwide, while in Nepal it has developed gradually over the years. In the early 1950s, just 2.9% of the population lived in urban areas, rising to 17.07% by 2011 and reaching 66.17% by 2021. Urbanization in Nepal has occurred on arable land, resulting in a 16.6% decline in agricultural area between 2068 and 2078 B.S. The urban landscape is reducing the availability of agricultural land, particularly around major cities in Nepal, such as Kathmandu, Pokhara, and Chitwan (NSO, 2025). Buildings are being constructed year-round in large numbers, with many more planned, replacing vegetated surfaces with paved, impervious ones in urban areas. This increases urban temperatures compared with rural areas because paved surfaces absorb, retain, and re-radiate solar energy more than vegetation (Jain & Janakiram, 2016). At the same time, domestic demand for floricultural products is increasing, and import opportunities are growing day by day. This rising demand for floricultural products, shrinking agricultural land, and rising temperatures due to rapid urbanization signal an urgent need for an innovative, land-conserving method with lower land requirements for urban environments in Nepal and around the world.

Despite the rapid adoption of vertical gardening in urban areas worldwide for the production of flowers and ornamental plants, its formal adoption in Nepal's floriculture sector remains very limited, and there is a lack of analysis and documentation on what it could offer in the Nepalese context. Therefore, this review aims to explore vertical gardening and its types, benefits, plant species suitable for vertical gardening, its suitability, opportunities, and challenges in urban floriculture in Nepal.

Types of vertical gardening

Jain & Janakiram (2016) identified the two major categories of vertical gardening or green walls are Green facades and Living walls. Greenfacades are built with climbing plants that grow directly on walls or on specially designed structures, where the shoot system grows up the side of the building and is rooted in the ground. In this system, vegetation is always attached to exterior walls, and some living walls can also be used for interior applications. The modular panel or living wall system is built with stainless steel, geotextiles, an irrigation system, growing media, and vegetation. The two categories, as described by the same document, are:

Container/ trellis system

Green facades, also known as container or trellis systems, evoke vines and climbers that grow from the ground or from large containers placed around buildings, using walls or supported structures such as mesh/trellis for support. This traditional system is widely used, and the process takes time to achieve full coverage. Climbing plants naturally spread across building surfaces and are sometimes guided upward by support structures.

Modular panel system

This system, also known as living walls, uses pre-planted panels or vertical modules with growing media that support plants attached to the wall or structural frame. This is the most recent innovation but requires careful planning, design, and proper installation to become fully functional.

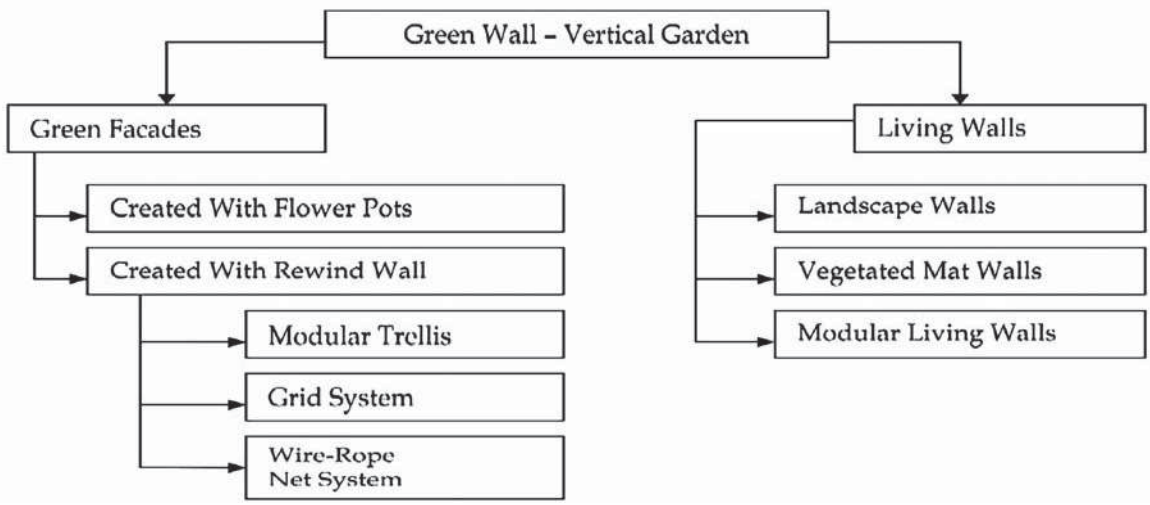

Fig. 1: Various types of vertical garden (Yeh, 2012; Malakar et al., 2017)

Ingole et al. (2025) have classified the vertical gardening systems into three categories: wall-mounted systems (living walls and modular panel systems), container-based systems (pocket gardens and vertical pots and planters), and hydroponics & aeroponics systems. Pocket gardens are small-scale vertical gardening systems in which pockets or pouches hold soil and plants. Pocket gardens can be made from various materials, such as fabric or plastic, and hung on walls or fences. In vertical pots, a variety of plants (herbs, flowers, and small fruits) can be grown effectively, which makes them versatile for urban gardening. In addition, vertical pots optimize space and allow the gardener to perform maintenance and harvesting more easily. Hydroponics and aeroponics are advanced techniques for vertical gardening in which plants are grown without soil, unlike traditional soil-based methods. Hydroponics is a method of growing plants in nutrient-rich water, and aeroponics is a method in which the roots are suspended in air, with nutrient-rich mist or aerosols supplied to nourish them.

Plants used in vertical gardening system

Right plant selection is important for successful growth and aesthetic appeal in vertical gardening, and the factors to consider are climate, light, and water requirements. Moisture-tolerant plants are essential for plant survival and growth in different systems of vertical gardening (Oyama et al., 2021; Ingole et al., 2025).The plants should have a short growth habit, a shallow, fibrous root system, a long life cycle that can withstand sun or full shade depending on location, and a

compact growth habit, i.e., capable of providing thick, dense cover (Jain & Janakiram, 2016).Low-maintenance plants such as Petunias, Ferns & succulents, seasonal flowering plants (Nasturtiums, Marigolds for providing a burst of seasonal color), and native and pollinator-friendly plants such as Coneflowers, Black- eyed Susans, for enhancing the ecosystem are the most essential categories of plants to use in vertical gardening (Ingole et al., 2025). When the right plants are selected, it only requires 3 to 4 times a year to remove dust, wilting foliage,& dead plants; for example, low maintenance requiring plants such as Pothos, Philodendron spp., Syngonium spp., and Bird nest fern (Jeyasurya et al., 2024; Kannan et al., 2016). For the modular panel system, evergreen plants are well-suited, as they photosynthesize year-round, continuously absorb carbon dioxide, and release oxygen for air purification (Perini et al., 2011).

Table 1: Plants suitable for vertical garden

Spaces	Suitable plants
Green Façades	*Hedera helix, Parthenocissus spp, Hydrangea petiolaris, Polygonum bauldschianicum, Lonicera spp. Clematis spp. Aristolochiaspp. Jasminum officinale, and Passiflora caerulea.*
Living Wall	*Dracaena, Phalaenopsis spp., Asparagus sprengeri, Kalanchoe, Cordyline spp. Chlorophytum spp., Haworthia spp., Tradescantia sp, Fittoniaspp, Nephrolepsis, Clematis, Gardenia spp., Asplenium nidus, Maranta spp., Cotoneaster, Euonymus fortune, Hedera, Hydrangea, Lonicera, Parthenocissus, Polygonum, Pyracantha, Selaginella, Wisteria, Rose, Petunia, Nasturtiums, Daisies, and Bromeliads.*
Exterior Wall	*Lavandula, Thymus, Rosmarinus or Salvia for full sunlight while Begonia, Arum, Davallia, Asplenium, and Fuchsia for shady locations.*
Interior Wall	*Philodendron, Epipremnum, Aeschynanthus, Columnea, Saintpaulia, Begonia, Nephrolepis, andPeperomia.*

Source: Jain & Janakiram (2016)

Table 2: List of plants suitable for vertical gardening

S.N.	Plant category	Name of plants
1.	Herbs	Basil, Rosemary, Thyme, Mint, Parsley
2.	Succulents	Sedum, Echeveria, Sempervivum (Hens and Chicks), Crassula
3.	Ferns	Boston Fern, Staghorn Fern, Maidenhair Fern, Bird's Nest Fern
4.	Vines and Climbers	Ivy, Pothos, Climbing Roses, Clematis
5.	Ornamental Grasses	Fountain Grass (Pennisetum), Blue Fescue (Festuca), Japanese Forest Grass (Hakonechloa)
6.	Annual Flowers	Petunias, Impatiens, Geraniums, Verbena
7.	Perennials	Hostas, Heuchera (Coral Bells), Tiarella (Foamflower), Ajuga (Bugleweed)
8.	Vegetables and Edible Plants	Lettuce, Strawberries, Tomatoes (dwarf varieties), Chard
9.	Native Plants	Choose native plants that thrive in your region for the best results.

Source: Pathania et al. (2023)

Benefits of vertical gardening

Vertical gardening has a range of well-documented benefits that directly counter the rising pressure of urbanization, declining agricultural land, and the growing demand for floricultural products in Nepal. These benefits span environmental, aesthetic, economic, and social dimensions, making vertical gardening an effective counterstrategy for urban floriculture in land-scarce cities.

Space utilization and land use efficiency

One of the best advantages of vertical gardening in urban floriculture is that it can transform the underutilized vertical spaces into productive areas without consuming additional ground space. Indoor and vertical gardening is an effective method that addresses the space limitations in urban areas by utilizing wall surfaces, balconies, and building facades for productive cultivation, a finding highly relevant to Nepal's rapidly shrinking urban agricultural land around the nation (Halgamuge et al., 2021; Naik et al., 2024). Growers can maximize the limited spaces while obtaining ecological benefits by the use of walls, fences, and other vertical structures to create a green environment (Ingole et al., 2025), a principle that applies to growers of Kathmandu, Bhaktapur, Lalitpur, and other cities where the horizontal lands are declining due to rapid urban expansion. Vertical gardens are an effective solution for converting areas covered by buildings into green spaces, maximizing space efficiency by integrating architectural and natural elements (Lee & Lee, 2024).

Environmental benefits: thermal regulation and urban heat island mitigation

Vertical gardening is important in Nepal, as rapid urbanization is replacing vegetated land with impervious surfaces, increasing the UHI effect. Alterations to the natural radiative balance caused by urbanization lead to the UHI, an unintended rise in urban temperatures compared to rural areas (Kotharkar et al., 2019). Susca et al.(2022) documented that a green wall can reduce the UHI up to ~5 °C in some areas, and it has the potential to reduce the UHI up to 8 °C in highly urbanized areas with narrow streets that are surrounded by high-rise buildings. Nugroho (2020) performed an experiment to reduce the effect of vertical gardens on the temperature and CO_2 levels in urban housing, and he found an average air temperature reduction of 0.75 °C and a surface temperature reduction of 16.4°C. In Nepal's cities, vertical gardens and commercial flower production units can meaningfully help cool urban microclimates, ensuring better growing conditions for heat-sensitive ornamental crops such as chrysanthemums, carnations, and gerberas.

Air quality improvements

Vertical gardens in urban floriculture settings improve air quality, aligning perfectly with the challenges of air quality in Nepal's urban cities, particularly in the Kathmandu Valley, which is consistently ranked among the most polluted cities in Southeast Asia. Vertical gardens outfitted with plants can reduce CO_2 and volatile organic compound levels by approximately 25% and 80%, respectively. The plants in green walls can filter airborne particles in their leaves and branches and also absorb gaseous pollutants, which ultimately improves the air quality (Jain & Janakiram, 2016).

Aesthetic and psychological benefits

Besides their environmental benefits, vertical gardening also has aesthetic and psychological benefits. A vertical garden combines ornamental and edible plants, creating visually appealing, productive spaces and covering walls with greenery, thereby enhancing their pictures que appeal (Arvapalli, 2026). It can convert dull, lifeless walls into vibrant, living masterpieces, enhance

the aesthetic appeal of homes, offices, and public spaces, and add a unique visual element to any environment (Yadav et al., 2024).Exposure to biophilic elements and views of greenery are strongly associated with increasing well-being, reduced stress, and greater comfort. In addition, visual appeal and the development of green spaces enhance streetscape aesthetics and strengthen cultural identity, especially in densely populated urban areas (Theodoridou et al., 2025).

Opportunities of vertical gardening in Nepal

As Nepal faces rapid urbanization pressures, rising consumer demand, and an expanding floriculture sector, vertical gardening has emerged as a promising and relevant solution for the country. The vertical gardening approach in urban floriculture aligns with the immediate need for an innovative, land-conserving method, as rapid urbanization is reducing the ground space. Urban floriculture through indoor and vertical gardening addresses the problem of space limitation in cities by utilizing wall surfaces, balconies, and building facades for growing different commercial ornamental crops, providing a year-round flower production opportunity where horizontal land is no longer available (Halgamuge et al., 2021; Naik et al., 2024), and the similar principle is applicable in urban cities of Nepal as the horizontal surfaces are declining and the vertical surfaces are not being utilized. There is a tremendous trade imbalance in floricultural products in Nepal: 80% of its exports consist of raw propagation materials, while 38.40% of all live plants and cut flowers are imported, especially from India. This imbalance can be directly reduced through vertical production, supplying domestic demand from cities within Nepal.

Ghimire et al.(2025)reported that vertical farming has the potential to transform the flower industry by providing sustainable, cost-effective, and seasonally independent growing conditions through microclimate regulation; this ultimately enables urban growers to supply high-quality flowers such as roses, gerberas, and chrysanthemums. The same article also documented those soilless technologies, such as hydroponics and aeroponics, within vertical systems can eliminate soil-borne diseases, conserve water, and open new urban production opportunities, including residential rooftop floriculture and indoor plantations, which are directly applicable to Nepal's spatially constrained urban enterprise. Nepal's domestic floriculture market demand is growing at 10% annually, and horizontal production alone is insufficient to meet this demand, creating an immediate commercial opportunity for urban vertical gardening enterprises in Kathmandu, Lalitpur, and Bhaktapur to retain commercial value domestically rather than channel it to Indian exporters. In 2022, Nepal exported cut flowers to Australia and Qatar, and specific flowers such as orchids were exported to Hong Kong, showing a growing but inefficient international market for Nepalese floriculture products, and Nepal has significant potential in the cut flower trade due to its unique agro-climatic conditions and the growing global demand for such products (Banstola & Acharya, 2024). Nepal has a reservoir of over 324 endemic species of plants, more than 500 species of native orchids, and more than 450 species of ferns, representing a vast, largely untapped biological resource for the ornamental plant industry (Gaire et al., 2023), which can be effectively utilized for vertical gardening in urban areas. The Floriculture Promotion Policy 2069 (2012), approved by the Government of Nepal, provides a fundamental policy foundation to support floriculture stakeholders in infrastructure and organizational development, and could be extended to include vertical gardening as a modern production strategy (Gaire et al., 2023).

Urban vertical gardening enables local production close to urban markets, which reduces supply costs, maintains freshness, and reduces Nepal's import dependence and post-harvest losses. The unused walls in Nepal's urban areas can be converted into beautiful, appealing surfaces that further emphasize the concept of a green city. The air quality in Nepal's urban areas can be improved through vertical gardening, which reduces carbon dioxide levels and acts as a biofilter, as noted in the reviewed articles above. The daily temperature rises, and hot climate conditions of Nepal can be countered naturally by vertical gardening, as it reduces the temperature and the UHI effect.

Challenges of vertical gardening in Nepal

Despite the opportunities mentioned above, the formal adoption of vertical gardening in Nepal is still undocumented and unpracticed. Along with the opportunities, it also faces technical, economic, climatic, and infrastructural challenges in Nepal. Installing a vertical garden requires specialized structures, irrigation systems, and proper plant selection, which can be expensive; regular monitoring, including watering, fertilization, and pest control, further enhances the cost (Khajuria & Mahajan, 2025), and many urban areas in Nepal may not have the financial resources or expertise to support large-scale implementation of vertical gardening. Private initiatives have been the main drivers of the floriculture industry in Nepal, while there is inadequate funding from the government for research, extension, and infrastructure, the floriculture sector's ability to adopt the vertical gardening system is directly hampered by the fact that only 14% of farmers get extension services and only 31% received training on production and marketing in floriculture (Acharya et al., 2022).

The floriculture industry in Nepal has found it relatively difficult to adopt even basic emerging technologies due to challenges such as high initial costs, technical skill requirements, and limited knowledge of advanced growing systems (Ghimire et al., 2025). These obstacles are proportionately greater for vertical gardening due to its complicated engineering and automation requirements. Periodic urban water availability in Nepal, particularly in the Kathmandu Valley, poses severe operational reliability risks for vertical garden irrigation systems, necessitating investments in rainwater harvesting and closed-loop recirculating irrigation to support sustainable, prosperous vertical floriculture, thereby further increasing installation costs. Adoption of vertical gardens is severely hindered by Nepal's largely unstructured urban building stock because not all structures are built to support the combined dead and live loads introduced by modular living wall systems, and retrofitting them without getting a certified structural engineering assessment increases the risk of water intrusion, mold growth, and façade damage (Khajuria & Mahajan, 2025).

To establish vertical greening systems for sustainability, an integrated design approach that can address structural load distribution, waterproofing, and facade protection is necessary (Farrokhirad et al., 2024). The lack of standard grading, packing, storage, and marketing systems significantly lowers the market value of flowers, despite the use of advanced production technology, posinga fundamental economic viability challenge for urban vertical floriculture. Furthermore, expertise in vertical gardening is lacking in Nepal, hindering its adoption; climatic variability also threatens the successful establishment of the plants used in vertical gardening.

Conclusion

Rapid urbanization in Nepal is displacing established flower growers and reshaping floriculture, making vertical gardening an urgent and strategic solution for the urban sector. These systems are technically adaptable

to Nepal's built environment and can support year-round commercial production of high-value ornamental crops, including roses, gerberas, carnations, and chrysanthemums (Ghimire et al., 2025), while delivering proven environmental benefits such as heat island mitigation, improved air quality, and enhanced well-being. Nepal's rich endemic ornamental plant diversity further offers a largely untapped resource for unique and commercially viable vertical installations. However, high installation costs, structural limitations of existing buildings, water scarcity, a lack of trained personnel, poor post-harvest management, and an inadequate Floriculture Promotion Policy remain critical barriers. Realizing the full potential of vertical gardening in Nepal's urban floriculture sector will require coordinated multi-stakeholder action, policy reform, targeted public investment, financial incentives, and dedicated training in smart cultivation technologies.

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Preliminary study report of Tulip Bulb production in Ilam and Manang District of Nepal

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Abstract

A preliminary field trial of Tulip was carried out in Jaubari of Ilam and Bhartang of Manang districts; both these locations are 2900masl or above and fall under snowfall region. Eight varieties of Tulip was tested in above two locations. All varieties performed well in both the locations with an average 3 daughter bulbs and 5-6 bulblets per bulb in both the locations. No disease and pest were observed during the time of the experiment. This preliminary research paves way for detail research to test the commercial production of Tulip bulbs in Nepal.

Keywords: Tulip, bulbs, bulblets, flowering pot plants

Introduction

Flowers and gardens have been part of Nepalese culture since time immemorial. This is primarily due to religious, aesthetic and social values attached to flowers and gardens. However, economic values of flowers and gardens are only of recent origin and are also gaining importance to beautify environment and reduce pollutions.Tulipa spp., belongs to family Liliaceae. It is originated from central Asia; Siberia, Mongolia, and China. Plants are generally found in hilly country with extremely cold winters and hot dry summers. With a history of more than 400 years, the tulip has become one of the world's most important ornamental plants. Over the centuries, intensive hybridization conducted primarily by growers in the world has resulted in strong and beautiful tulip cultivars. Tulip is a bulbous plant. Its bulb is made up of scales growing from the base plate. These scales surround the apical meristem located in the middle of the bulb. Daughter bulb offsets from vegetative axillary buds in the axils of the tunicated scales. It takes 2 to 3 years to produce a commercial size bulb capable of flowering.

Usually, Tulips has two life cycles. In the first cycle of growth, the roots start growing from the bulb to form a strong root system. In the second life stage of tulips, when the snow-covered soil begins to thaw towards the end of winter, a healthy green shoot starts coming out from a tulip bulb. After 2 months, the tulips would start to bloom. During the flowering season the leaves of the tulips develop.The foliage (green leaves) plays an important role in the life cycle of tulips. The leaves of the tulips should never be cut. They are responsible for the process of photosynthesis. The food derived from the solar energy is stored in the form of carbohydrate in the bulbs. This food is required for the growth and the flowering process of tulip in the following year. Gradually, the leaves turn yellow and wither away and the tulip bulbs enter a state of dormancy after completing the yearly cycle.

Due to the geographical and climatic conditions of Nepal, tulip flower as well as bulb production can be successful in high hills and mountains. In the early 1990s, several varieties of Tulip were tested in a village of Mustang district with successful production of flowers. However, during that time there was no access road to the district and road was under construction from Pokhara towards Kusma and Baglung. There is no report of the bulb formation earlier. Besides, with better road

connectivity there is scope for growing Tulips in the high hills and mountains and transporting them to cities for pot plants or garden landscape plants. Tulip bulbs are popular planting materials for gardens in Nepal and are in huge demand both in Nepal and India. There could be possibility for commercial production of Tulip bulbs in Nepal and for that there is need to test tulip bulb production in Nepal.

Objectives of the study

- To assess the feasibility for the bulb production of Tulip in Ilam and Manang Districts

Methodology

The detail information regarding pilot study, location of experiment, growing condition and production techniques adopted during planting to harvesting of Tulip flower are described as below.

Study Districts

Two districts Ilam and Manang were selected for the study of Tulip bulb production.

Site Selection

After discussion with FAN, Nepal Horticulture Society and MoAD; Agricultural Research Station Jaubari (2900masl), Ilam and Agro Manang Farm, Bhartang (2950masl), Manangwere selected for the planting sites because both these locations is subjected to low temperature and experiences snowfall in winter.

Experimental sites

One of the sites of the experiment was in Agricultural Research Station Jaubari (Ilam) where the average maximum temperature was 24°C and minimum average temperature was 0°C. Similarly, the other site of the experiment was in Agro Manang Farm, Bhartang where the average maximum temperature was 21°C and average maximum temperature was -4°C.

Duration of the study

The experiments in two sites were carried out from Poush 2073 to Ashar 2074.

Plant materials

About 1000 bulb of 8 different cultivars were provided by FAN to each experimental site and best and uniform bulbs were used for this research (Table 1).

Table 1: Varieties used for study in both sites (Ilam and Manang)

SN	Description of variety	Quantity
1	Set. Aafke ®	90
2	Tt. Ben van Zanten ®	90
3	Det. Largo ®	90
4	Tt. Sevilla	90
5	Tt. Snowboard ®	90
6	Tt. Strong Gold	90
7	Dht. World's Favourite ®	90
8	Tt. Barcelona	90

Preparation of the experimental plot

The land was brought to a good tilth by two deep ploughing. Before leveling of experimental plot, weeds and left over crop residues were removed. Weeding and removing of left over residues was followed by digging and leveling. The experimental plots were raised to about 10 cm above ground level to prevent from water logging. 8 different beds (research plots) were prepared of 50 cm in both of the experimental sites.

Planting

In each site, 720 bulbs of tulip were planted by maintaining the spacing of 8 cm bulb-to-bulb and 12 cm row-to-row distance after completion of layout design.

Manures and fertilizers

Fifteen days before planting, well decomposed farm yard manure (FYM) was applied at the rate of 5 kg in each plot. No chemical fertilizers were applied.

Intercultural operations

All the intercultural operations like hoeing; weeding, irrigation and mulching were done regularly. Weeding was mostly done manually with hand. Hoeing and weeding was done at the same time as and when required to control weeds. Irrigation was provided with watering pipes at 2-3 days interval to maintain optimum water regime for plant growth and development.

Data collection, observation and analytical techniques

Primary data related to production technology of tulips, major technical problems, number of daughter bulb formed per bulb, number of bulblets per bulb were collected. The experimental sites were monitored two times in each site by the technical person of FAN.

Results

Ilam District

Geographical and climatic conditions of Ilam

Ilam lies in Eastern region of Nepal, from 87° 55' 35" East latitude and 26° 54' 30" North longitude. The altitude of Ilam varies from sea level of 300 m to 3636 m and district headquarter is on 1200 m altitude. The district is a mountainous terrain and rises from 140m above sea level at Setibeni to 3,636m at Sandakpur covering an area of 1,714 sq km, making up 1.16 percent of the total land area of Nepal. The district is bordered by Panchthar in the North West, Morang in the South West, Jhapa in the South East and India's Darjeeling District in the East. Ilam has wide climatic variation consisting of lower tropical, sub-tropical and temperate region. Average annual Min. and Max. temperature were -10 °C and 34°C respectively. Thus, it was found that Ilam, technically, was the potential district for commercial bulb cultivation.

Disease and pest infestation

As the trial was conducted in the high hills, no disease and pest infestation have been recorded.

Bulb Production

Bulb formation occurred in tulips after the yellowing of leaves. Almost all bulbs produced 3 big bulbs and 4-5 small corms from each single tulip which is normal for an ideal Tulip bulb production.

Manang District

Geographical and climatic conditions of Manang

Manang district lies in Western region of Nepal. The district covers an area of 2,246 sq. km and

elevation ranges from 1,880 to 8,156 metres. There are several peaks above 7,000 metres and two over 8000 metres. It is a tectonic basin stretching from 84° 1' 0" East latitude and 28° 40' 0" North longitude.Thus, Manang was also technically potential district for commercial bulb cultivation.

Disease and pest infestation

As the trial was conducted in the high hills, no disease and pest infestation have been recorded.

Bulb Production

Bulb formation occurred in tulips after the yellowing of leaves. Almost all bulbs produced 3 big bulbs and 4-5 small cormlets from each single tulip which is normal for an ideal Tulip bulb production.



Bed preparation and planting



Tulips flowering in plot



Harvested bulbs of Tulip

Discussion

This preliminary research has indicated that bulb production of several varieties of Tulip was possible in Jaubari of Ilam and Bhartang of Manang districts of Nepal. Further research should be undertaken to test commercial production of Tulip both for bulbs and flowering pot plant production. Earlier, in 1990s, successful production of Tulip was done in Mustang but due to no road access, there is no report of sales of Tulip flowers in Pokhara or other cities. Then there was only air transport for short and swift transport from Jomsom (Mustang) to Pokhara and the freight cost would be expensive. However, presently, there is all terrain road access from Bhartang and Jaubari or Mustang to all the major cities of Nepal with occasional landslides during the monsoon season. Nevertheless, the road access would have no problem when Tulip plants with flowers can be transported during March-April to any part of the country. Besides, Tulip bulb after harvesting can be stored in an airy and well-ventilated storage at the site of production and transported in October for market distribution which coincides with bulb planting time in Nepal. The post-monsoon road is often very reliable, could be rough in some stretches but no landslides.

Future research should have major parameters such as testing different varieties, planting time, days to emergence, days to flower bud emergence, days to flowering, transportation and shelf life of flowering potted plants, nutrition management, bulb formation etc. Since, there is high demand of Tulip bulbs and flowering Tulip plants in South Asia it may be possible to cultivate tulip for domestic as well as export market. Strong research on Tulip could pave way for foreign direct investment from major Tulip breeders and planting materials producers. Besides, direct air connectivity from Pokhara to South Asian and West Asian cities could easily provide opportunity to transport Tulip flowering plants from Mustang and Manang.





Growing Tulip at Manang





Flowering of Tulips in Field

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प्रो. उत्तम तिमल्सिना

फोन: ९८५१०७२४४१, ९८४१६३०५७८

तिमल्सिना नर्सरी

सानागाउँ, ललितपुर







हाम्रा सेवाहरू:

यहाँ विभिन्न जातका फूल, फलका विरूवाहरू पाउनुको साथै घर अनुसार बगैंचा डिजाइन, आइल्याण्ड निमार्ण र झरना पनि बनाइन्छ ।

Kaphal (*Myrica esculenta*): Possibility as an ornamental fruit plant for garden and landscape of Nepal

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Abstract

Myrica esculenta, a dioecious species, is native to Nepal extending throughout mid-hill regions of Nepal.It is locally known as Kaphal/Kafal. This species is important in many ways, popular as a fruit of exquisite taste, unique color and varied medicinal properties. The *M. esculenta* is economically, socially, culturally and medicinally important tree species of Nepal. The utilization of Kaphal in Nepal as horticultural crop is increasing day by day but the status of its domestication is still in infancy stage. Despite its importance, the priority of government and non-governmental organization in its research and development seems to be negligent. It is the need of time to properly recognize its value and give due importance in terms of research and developmental activities including domestication approaches and conservation programs. Kaphal can be utilized as a specimen plants in the garden as well as can be utilized as a part of landscape integrating its production and promoting agro-tourism especially along the highway corridors of Nepal. This article highlights the importance of Kaphal (*M. esculenta*) and its status with regard to its utilization, economic and nutritional contribution to Nepalese communities along with its potential ornamental values for landscape and garden uses and role in agro-tourism.

Keywords: Kaphal, shrub, ornamental, edible

Introduction

Kaphal (*Myrica esculenta*Buch.-Ham. ex D. Don)commonly known as box myrtle, is an underutilized and indigenous fruit species of Nepal valued for its juicy fruits as well as other medicinal properties (Rymbai et al., 2016; Thapa et al., 2021). It is known as Kaphal/Kafal in Nepali. It belongs to family Myricaceae, and is a dioecious tree species, having male (nonbearing, pollen source tree) and female (fruit bearing trees) with anemophilous (wind pollinated) type of pollination (Khanduri & Sukumaran, 2019; Chanu et al., 2024). It is native of the Himalayan region and is distributed in Nepal, India; Chinaand South East Asiaand is regarded as one the delicious wild fruits of sub-Himalayan region (Lata et al., 2021). Kaphal is used as fresh fruit or in drinks and also used for tanning purpose. It is also used as pickle (Deka and Rymbai, 2014). Few years ago, one of the wards of Ribdikot rural municipality in Palpa reportedly sold Kaphal fruit worth about NPR 1.0 million (Pers. Communication Sanjay Dhimal, July 2024). In 2026, the price of Kaphalin online market of Kathmandu was NPR 1600 per kg. Kaphaltree is also usedas a garden plant or avenue plant in Japan. Lately, Kaphal leaves are also used as cut foliage in Nepali flower industry. This paper highlights the possibility of the use of this beautiful plant in the gardens and landscape of Nepal in addition to economic and nutritional importance.

Botanical description and species distribution in Nepal

Myrica esculenta is an evergreen tree with height reaching up to 10 meter having dioecious nature with aromatic fragrance of leaves. Male inflorescence is branched while females are erect in nature known as catkins. Fruit is characterized as a drupe with hard endocarp and size ranging from 1.1 to 1.3 cm diameter showing attractive red color (Saiju, 2023; Chanu et al., 2024). Flowering and fruiting The reported flowering time is October-November and fruiting time is March-April in all

NEH regions in India (Deka & Rymbai, 2014). In Nepal, it is reported to be flowering in the month of February and fruit ripening in May-June (Thapa et al., 2021; Saiju, 2023). The flowering, fruiting and tree characters of Kaphalare shown in Figure 1.

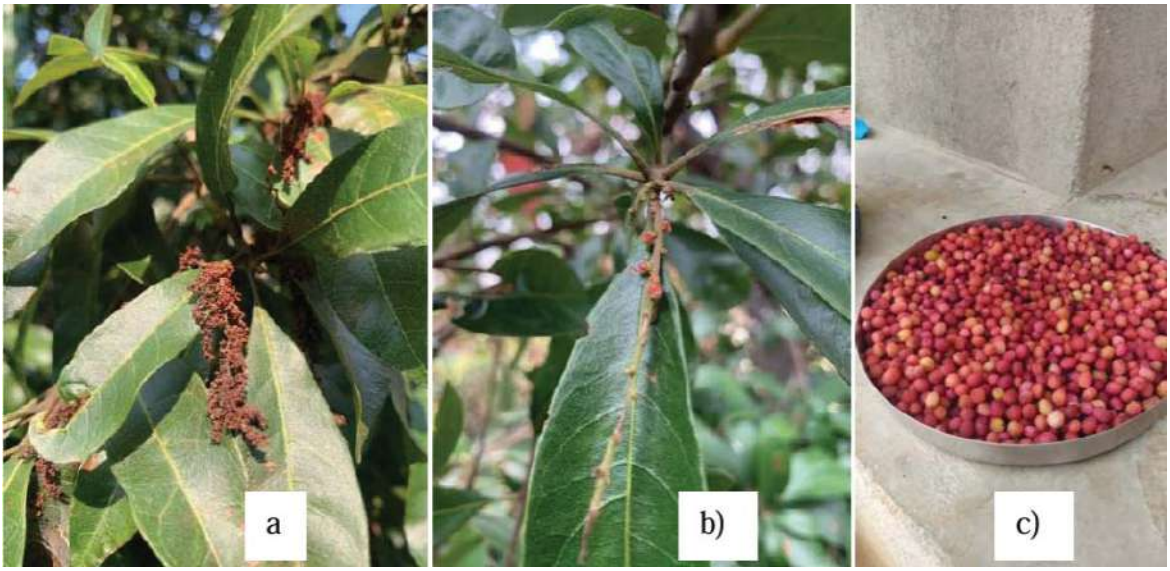

Figure 1. a) Female inflorescence, b) Male inflorescence, c)Mature harvested fruits of Kaphal, d) Mature old tree of Kaphal at Dadeldhura district, e) Fruiting trees of Kaphal and manual harvesting of mature fruits



Distribution in Nepal

M. esulenta is reported to grow well between 900-2100 masl with sub-temperate/subtropical distribution in the Himalayan region (Chanu et al., 2024; Rawale et al., 2024) with population abundance at the altitude of 1500-1800 masl. It is reported to be found at altitude between 1200-2300 masl (ICIMOD, n.d.; Saiju, 2023). This species prefers moist areas and commonly associated with oak and pine forests with 15-26% of total tree density of the forests and is correlated with pinus tree biomass (Bhatt et al., 2000; Barola et al., 2016). Based on field observation, the trees are also reported sparsely at lower elevations around 800m. The flowering and fruiting can happen at low altitude around 630 masl as known in Sundarbazar, Lamjung campus area thus exhibiting potential to be shifted at lower altitudes too.

Importance and uses of Myrica esculenta

M. esculenta is a multipurpose fruit tree with high medicinal value and have its medicinal importance in ayurvedic system of medicine. The fruits are rich in ascorbic acid (Vitamin C) content as well as antioxidants with anticancer, anti-inflammatory, antidiabetic, antimicrobial, and antifungal activities (Pandey et al., 2017; Bhatt et al., 2023; Das et al., 2024). *M. esculenta* is considered a medicinal plant showing free radical scavenging and glucose lowering effect of bark and small branches extracts thus exhibiting antioxidant properties (Baral et al., 2022). Kaphal is used to cure gastrointestinal problems like diarrhea and dysentery, cure bronchitis as well as to mollify rheumatic pain which is being practiced by local people in Magar community of western Nepal (Singh et al., 2011). In Nepal, Kaphal (*M.esculenta*) has been identified as tree species having higher socioeconomic values which have also been important tree species in Uttarakhand area in India (Pandey et al., 2024) and hence need priority for conservation in-situ. This is indeed true in case of Nepal where the fruits are appreciated much during the month of May-June with price per kg ranging from NRs.400-1600.

Ornamental potential and domestication

M.esculenta, is an evergreen species with dense foliage (Shukla et al., 2017). The leaves are characterized by dark to light green leaves and tree bears profuse branching and attains a height of 10-15m (Lata et al., 2021, Saiju, 2023). Owing to its colorful fruits and dense foliage, this species can be utilized as an ornamental plant in the garden as a specimen tree. The purple to red fruits may add beauty to the overall garden beautification. The birds are attracted for eating fruits and thus have the potential to add diversity of bird population in the garden. The related species of the family Myricaceae, Myrica faya was reported to be used as an ornamental shade tree at the side of the lakes as well as windbreaks, characteristics similar (non-deciduous, dark green to light green leaves) to that of *M. esculenta* (Lutzow-Felling et al., 1995). Thus Kaphal plants have the potential ornamental values along with role in soil fertility restoration and hence can be introduced in the landscapes and gardens of Nepal. In Nepal, lately cut foliage has been used for floral decoration and is largely supplied from the mid-hills of Nepal. Its dark green glossy leaves and longer shelf life has been preferred by the florists and about 70MT (cut foliage) is estimated to be consumed annually in Nepal with a turnover of about NPR 10.0 million (Pers. communication. Bishwamani Pokhrel, 2nd October 2026). The use of Kafal trees, a native ornamental fruit plant in the landscape could create new product and add economic value to the nursery business.

The population of *M. esculenta* is quite good in the sloppy land of the mid-hill regions of Nepal. For example, the tree population along the highway of Far-Western mid-hill region from Sahajpur, Kailali (around 1240 masl) to the Syaule, Dadeldhura (around 1600 masl) in Far-Western region is quite fascinating. The farmers collect the fruits from the wild and semi-domesticated trees (natural

tree populations in their fields) and sell in the highway corridors. The act of selling and attracting the tourists with their unique behavior and skills is a part of agro-tourism in such regions. This shows that such regions can be planted with Kaphal trees and can be made trails for those who want to enjoy the harvesting process of Kaphal and get pleasure from the harvested fruits. The potentiality of *M. esculenta* is thus enormous in terms of its utilization in Nepalese conditions in addition to their economical and medicinal importance. It can serve as a role in soil erosion control and nutrient enrichment in sloppy and marginal lands of Nepal since it is nitrogen fixing treesand nodulated by *Frankia* (Barola et al., 2016; Borthakur & Neog, 2023) as well as grows and adapt well in sloppy and marginal land. Barola et al. (2016) recommended planting female trees in higher altitudes for the conservation of species as well as higher economic profits. Through selective vegetative propagation methods such as micro-propagation, female plants can be obtained without having to wait for sex determination till maturity (Bhatt & Dhar, 2004).

Various studies have been conducted in order to know the propagation techniques of *M. esculenta*, such as seed, cutting, air layering, suckers as well as micro-propagation (Shukla et al., 2017; Lal et al., 2021). The natural regeneration ability of Kaphalis not well in its habitat (Bhatt et al., 2000) and hence may require human intervention for successful establishment. There has been growing concern for sustainable harvesting, utilization and conservation of this native species (Shivandu et al., 2022) thus need domestication approaches and conservation strategies. Seed propagation require stratification for breaking seed dormancy caused by hard seed coat, scarification at micropyle end, cuttings during July-August can be used with hormonal treatment ((Bhatt et al., 2000a;Purohit et al., 2004; Chaukiyal, 2015; Shukla et al., 2017; Hazarika et al., 2023). The hot water and GA3 treatment can help to promote seed germination although seed germination in *M. esculenta* is low despite presowing treatment (Rawale et al., 2024). These findings may be useful to start raising saplings of Kaphal and start domestication programs. Furthermore, research regarding propagation protocol need to be developed in Nepal for successful introduction in the landscapes and garden in Nepal. As the demand for fresh fruits is high in the market during the fruiting season, it is in fact essential to make efforts to domesticate and produce good quality fruits for consumers. It is important to note that in hilly areas, people have managed natural populations of *M. esculenta* in their own land and utilize for their need of nutrition. This is true in case of other underutilized fruits too. However, proper domestication is yet to happen in case of Kaphal and hence require attention for research in terms of evaluation of genetic diversity, selection of superior quality fruits and propagation and sapling production of Kaphal for distribution and mass planting.

Research and future areas

Nepal is a hotspot area of *M.esculenta* and is considered a valuable fruit tree species despite categorized as underutilized fruit. It has a long history of its use, however, the research and developmental effort in the domestication of this species is still bare minimum. Being valued as a tree species for food nutrition and security (Adhikari et al., 2016), it needs to get national research priority in terms of diversity assessment, species distribution, propagation, and domestication approaches, among others. Few research areas that need to be studied are:

- Distribution of *M. esculenta* in Nepal and its diversity assessment.
- Propagation studies including grafting and domestication approaches including commercial sapling production.
- Post-harvest studies and strategies to utilize the fruit owing to its less shelf-life.
- Value addition and commercial utilization

- Introduction of *M. esculenta* tree in gardens, parks, river corridors or avenue plantation in the highways.
- Post-harvest studies of the shelf life of cut foliages.

Conclusion

Kaphal is an ecologically, ornamentally, nutritionally, medicinally important underutilized and indigenous fruit species of Nepal. Although highly valued fruit crops, it doesn't get enough attention in terms of research and developmental efforts from the nation till date. The growing anthropogenic pressure on its harvesting, habitat destruction due to deforestation is a concern for its conservation in the natural ecosystem thus needs proper evaluation and subsequent domestication and utilization. This species has the potential to be utilized as a garden specimen plant and as avenue trees along the highway and river corridors of Nepal owing to its evergreen beautiful foliage and attractive fruits.

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हाम्रो सेवाहरू: यहाँ विभिन्न जातका विरुवाहरु पाउनुका साथै बगैंचा सम्बन्धि सम्पूर्ण कार्य गरिन्छ ।

Traditionally Consumed Edible Flowers in Nepal: Diversity, Culinary Uses & Ethnobotanical Knowledge

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Abstract

Edible flowers constitute an important but comparatively under-documented component of traditional food systems worldwide. In Nepal, knowledge concerning the culinary use of flowers is dispersed across ethnobotanical studies, wild-edible-plant inventories and community-specific food research, making it difficult to distinguish explicitly documented floral foods from plants whose other parts are edible. This review critically identified and synthesized Nepal-based evidence for the intentional human consumption of flowers, flower buds, inflorescences and floral nectar. A structured literature search was undertaken, followed by source-level verification using strict inclusion and exclusion criteria. Scientific names and family assignments were standardized against Kew Plants of the World Online (POWO). Fifteen species belonging to 14 genera and 10 families met the defined verification criteria and constitute the confirmed core inventory. Fabaceae was the most represented family, with four species, followed by Sapotaceae and Euphorbiaceae with two species each. Documented culinary practices included the consumption of flowers and buds as vegetables and pickles, raw or fresh flowers, direct consumption of floral nectar or juice, and the use of flowers in beverage or alcoholic preparations. Verified records originated from several geographical and cultural settings and included knowledge documented among Raji, Chepang and Tharu communities. However, the available literature is geographically uneven, and information on preparation methods, consumption frequency, seasonality and knowledge transmission remains incomplete. The 15 confirmed species should therefore be regarded as a minimum documented inventory rather than an estimate of Nepal's total edible-flower diversity. Further community-level and geographically balanced research is required to document and preserve Nepal's edible-flower food heritage.

Keywords: edible flowers; ethnobotany; traditional food; wild edible plants; indigenous knowledge; Nepal; food heritage

1. Introduction

Edible flowers have long formed part of traditional food systems worldwide.In many Asian and Himalayan food cultures they are consumed fresh, cooked, pickled, preserved or used in beverages and other preparations (Fernandes et al., 2017; Takahashi et al., 2020; Thapa et al., 2025; Samkaria & Kumari, 2025). Although research coverage remains geographically uneven (Chaudhary et al., 2025), Nepal's ecological and cultural diversity supports rich wild-food traditions, with 634 wild edible plant species documented across 52 of 77 districts. Edible flowers represent a small and poorly synthesized component of this knowledge, with records scattered across ethno botanical and wild-edible-plant studies. For this review, an edible floral resource is defined as flower, flower bud, inflorescence, floral nectar or other clearly identified floral structure intentionally consumed as food or used in food preparation. Only records explicitly documenting consumption of the floral part are included. Flowers used for medicinal, ritual or ornamental use are excluded. Although

Nepal has extensive literature on wild edible plants, edible flowers have not been systematically reviewed as a distinct food resource. Moreover, the inclusion of a plant in a wild-edible-plant inventory does not necessarily indicate that its flowers are consumed (Shrestha, 2013; Gautam et al., 2022). A critical verification of flower-specific culinary records is therefore necessary. This review establishes a conservative inventory of 15 confirmed edible-flower species in Nepal. It aims to: 1) Identify and taxonomically standardize species with explicitly documented culinary use of floral structures; 2) Examine their traditional preparation and consumption; 3) Assess geographical and cultural patterns of documented use; and 4) Identify major gaps in edible-flower research and documentation. Together, these objectives provide a conservative, evidence-based baseline of Nepal's documented edible-flower knowledge.

2. Methodology

2.1 Literature search and selection criteria: Literature available up to September 2026 was searched using Google Scholar, PubMed/PubMed Central (PMC), and Nepal Journals Online (NepJOL). Searches combined Nepal with terms including edible flower, wild edible plant, ethnobotany, flower, flower bud, floral nectar, vegetable and pickle. Species identified from broader ethnobotanical literature were further searched using scientific names, synonyms and vernacular names.

Records were included when they concerned Nepal, explicitly identified a floral structure, and documented its intentional culinary use. Records referring only to non-floral plant parts or solely to medicinal, ritual, ornamental or fodder uses were excluded. Ambiguous records were also excluded, and secondary records were traced to primary sources where possible.

2.2 Data extraction, verification and taxonomic standardization: For each eligible record, scientific name, family, vernacular name, floral part, culinary use, location, community, season and source were extracted. Missing information was recorded as NR and was not inferred. Primary sources were given greater evidentiary weight than secondary compilations, and conflicting or unverifiable records were excluded. Scientific names, authorship and family placement were standardized according to Plants of the World Online (POWO), Royal Botanic Gardens, Kew, with relevant synonyms retained for traceability. Application of these criteria identified 15 confirmed species, representing a minimum documented baseline of traditionally consumed edible flowers in Nepal, rather than the country's total edible-flower diversity.

3. Diversity of Confirmed Edible Flowers in Nepal

3.1 Taxonomic diversity: The confirmed inventory comprised 15 species belonging to 14 genera and 10 families (Table 1). Fabaceae was the most represented family, with four species (26.7%), followed by Sapotaceae and Euphorbiaceae, with two species each (13.3%). The remaining seven families were represented by one species each.At the genus level, *Bauhinia* was the only genus represented by two species, B. purpurea and *B. variegata*; all other genera were represented by a single species. The distribution across 10 families indicates a relatively broad taxonomic range. However, this pattern reflects the currently verified literature-based inventory and should not be interpreted as the overall taxonomic distribution of edible flowers consumed in Nepal.

Table 1. Confirmed edible flowers and floral resources documented in Nepal

Scientific name	Family	Local name(s) reported	Floral part consumed	Documented culinary use	Location/ community	Primary source(s)
Justiciaadhatoda L.	Acanthaceae	Asuro; Asur (Raji)	Flower nectar/ juice	Juice sucked directly from flowers	Surkhet and Kailali; Raji	Thapa et al. (2014)
Bauhinia purpurea L.	Fabaceae	Tanki	Flowers	Flowers eaten as vegetable	Central and western Nepal	Uprety et al. (2012)
Bauhinia variegata L.	Fabaceae	Koiralo; Koilar	Flowers/ buds	Vegetable; pickle	Central and western Nepal; also documented among Raji and other communities	Acharya & Acharya (2010); Limbu & Thapa (2011); Uprety et al. (2012); Thapa et al. (2014)
Bombax ceiba L.	Malvaceae	Simal; Samura; Semara	Young flowers /flowers	Vegetable	Central and western Nepal	Acharya & Acharya (2010); Uprety et al. (2012)
Rhododendron arboreum Sm.	Ericaceae	Lali Gurans/ Gurans	Flowers	Raw; flower juice	Western Nepal; including Raji	Thapa et al. (2014);
Woodfordiafruticosa (L.) Kurz	Lythraceae	Dhayero/ Dhairo; Dhairee (Raji)	Floral nectar	Nectar/juice sucked directly from flowers	Rupandehi; western Nepal including Raji	Acharya & Acharya (2010); Thapa et al. (2014)
Diploknemabutyracea (Roxb.) H.J.Lam	Sapotaceae	Chiuri	Floral nectar	Nectar from flowers consumed/ drunk	Rupandehi	Acharya & Acharya (2010)
*Ougeiniaoojeinensis (Roxb.) Hochr.	Fabaceae	Sadhan/ Panan	Flowers	Pickle	Rupandehi	Acharya & Acharya (2010)
Indigofera atropurpurea Buch.-Ham. ex Hornem.	Fabaceae	Sakhino/ Jhimiliya	Flowers	Vegetable; pickle	Rupandehi	Acharya & Acharya (2010)
*Euphorbia royleana*Boiss	Euphorbiaceae	Siudi	Flowers	Reported as vegetable	Dhankuta, eastern Nepal	Shrestha (2021)
Ricinus communis L.	Euphorbiaceae	Ander	Flowers	Reported as vegetable	Dhankuta, eastern Nepal	Shrestha (2021)
Dilleniapentagyna Roxb.	Dilleniaceae	Agaie (Tharu)	Flowers	Young shoots and flowers eaten as vegetable	Central and western Nepal; Tharu name recorded	Uprety et al. (2012)
Madhucalongifolia (L.) J.F.Macbr.	Sapotaceae	Mahuwa (Tharu)	Succulent flowers	Eaten fresh; flowers also used to make local liquor	Central and western Nepal	Uprety et al. (2012)
Smilax aspera L.	Smilacaceae	Kukurdaino	Flowers	Flowers used to make pickle	Central and western Nepal	Uprety et al. (2012)
Girardiniadiversifolia (Link) Friis	Urticaceae	-	Flowers	Tender shoots and flowers consumed as vegetable	Chepang communities, Gorkha and Tanahun	Limbu & Thapa (2011)

**Ougeiniaoojeinensis (Roxb.) Hochr.[syn. Desmodiumoojeinense (Roxb.) H.Ohashi]*

3.2 Diversity of floral structures consumed: The documented edible resources included several floral structures. Whole flowers were most frequently reported, while more specific records included the young flowers of *Bombax ceiba*, flower buds of *Bauhinia* variegata, and succulent flowers of *Madhucalongifolia*. Floral nectar or flower juice was also consumed from species including *Justiciaadhatoda*, *Woodfordiafruticosa*, and *Diploknemabutyracea*. These records show that edible floral resources extend beyond whole flowers to include buds, young flowers and floral nectar.

4. Traditional Culinary Uses

The confirmed edible-flower species were used in several culinary forms, including as vegetables, pickles, fresh foods, floral nectar or juice, and ingredients in alcoholic preparations (Table 2). Consumption as a vegetable was one of the most frequently documented uses. Flowers of *Bauhinia* purpurea and *B. variegata* were reported as vegetables, as were the young flowers of *Bombax ceiba*. Other documented floral vegetables included *Dilleniapentagyna*, *Indigoferaatropurpurea*, and *Girardiniadiversifolia*. Flowers of *Euphorbia royleana* and *Ricinuscommunis* were also reported as vegetables in eastern Nepal, although these ethnobotanical records should not be interpreted as evidence of toxicological safety. Pickling was documented for *Bauhinia* variegata, *Ougeiniaoojeinensis*, *Indigoferaatropurpurea*, and *Smilax aspera*. *B. variegata* was particularly well documented; among the Raji of western Nepal, its flowers were boiled, dried and subsequently used for pickle preparation (Thapa et al., 2014). Other Nepalese studies also reported its flowers or buds as pickles. Raw or fresh consumption was documented for *Madhucalongifolia* and *Rhododendron arboreum*. The succulent flowers of *M. longifolia* were consumed fresh, whereas flowers of *R. arboreum* were eaten raw. A distinctive practice was the direct consumption of floral nectar or juice. Among Raji communities of western Nepal, flower juice from *Justiciaadhatoda* and *Woodfordiafruticosa* was sucked directly from the flowers (Thapa et al., 2014). In Rupandehi, floral nectar of *Diploknemabutyracea* was also consumed directly, with children specifically reported among its consumers (Acharya & Acharya, 2010). This form of use broadens the concept of edible floral resources beyond the consumption of floral tissues. Flowers were also incorporated into alcoholic preparations. The succulent flowers of *Madhucalongifolia*, in addition to being eaten fresh, were used to prepare local liquor (Uprety et al., 2012).

Table 2. Traditional culinary uses of confirmed edible flowers in Nepal

Species	Floral part	Use category	Documented preparation/use	Source
Justiciaadhatoda	Flower juice/nectar	Nectar/ juice	Flower juice sucked directly	Thapa et al., 2014
Bauhinia purpurea	Flowers	Vegetable	Flowers consumed as vegetable	Uprety et al., 2012
Bauhinia variegata	Flowers/ buds	Vegetable; pickle	Vegetable; flowers/buds prepared as pickle; Raji record: flowers boiled and dried before pickle preparation	Acharya & Acharya, 2010; Limbu & Thapa, 2011; Uprety et al., 2012; Thapa et al., 2014

Bombax ceiba	Young flowers/ flowers	Vegetable	Young flowers/flowers consumed as vegetable	Acharya & Acharya, 2010; Uprety et al., 2012
Rhododendron arboreum	Flowers	Raw/fresh; juice	Flowers consumed raw in small quantities; flower juice also consumed	Thapa et al., 2014
Woodfordiafruticosa	Floral nectar/juice	Nectar/ juice	Floral nectar/juice consumed directly	Acharya & Acharya, 2010; Thapa et al., 2014
Diploknemabutyracea	Floral nectar	Nectar	Nectar consumed directly; children specifically reported among consumers	Acharya & Acharya, 2010
Ougeiniaoojeinensis	Flowers	Pickle	Flowers prepared as pickle	Acharya & Acharya, 2010
Indigoferaatropurpurea	Flowers	Vegetable; pickle	Flowers consumed as vegetable and pickle	Acharya & Acharya, 2010
Euphorbia royleana	Flowers	Vegetable	Reported ethnobotanically as vegetable[1]	Shrestha, 2021
Ricinus communis	Flowers	Vegetable	Reported ethnobotanically as vegetable[1]	Shrestha, 2021
Dilleniapentagyna	Flowers	Vegetable	Young shoots and flowers consumed as vegetable	Uprety et al., 2012
Madhucalongifolia	Succulent flowers	Raw/fresh; alcohol	Flowers consumed fresh and used to prepare local liquor	Uprety et al., 2012
Smilax aspera	Flowers	Pickle	Flowers prepared as pickle	Uprety et al., 2012
Girardiniadiversifolia	Flowers	Vegetable	Tender shoots and flowers consumed as vegetables	Limbu & Thapa, 2011

Note. Use categories reflect only culinary uses explicitly documented in the reviewed sources. [1] Records for *Euphorbia royleana* and Ricinus communis are ethnobotanical reports of food use and should not be interpreted as evidence of toxicological safety.

5. Geographic and Cultural Dimensions of Edible-Flower Knowledge

5.1 Geographic distribution of documented records

Confirmed edible-flower records were distributed across eastern, central and western Nepal, although geographical coverage was uneven. Eastern records included Dhankuta, while central and western records originated from study areas including Rupandehi, Makwanpur, Gorkha, Tanahun, Dang, Bardiya, Kailali and Surkhet. The mid-hills are comparatively well represented in Nepalese wild-edible-plant research, consistent with broader patterns of WEP documentation reported by Chaudhary et al. (2025). Edible-flower use was also documented in Terai and lowland areas. In Rupandehi, for example, recorded floral resources included *Bauhinia* variegata, *Bombax ceiba*, *Ougeiniaoojeinensis*, *Indigoferaatropurpurea*, *Diploknemabutyracea*, and *Woodfordiafruticosa* (Acharya & Acharya, 2010). These geographical patterns should be interpreted cautiously. Greater representation in the literature does not necessarily indicate greater edible-flower diversity or use, but may partly reflect uneven research effort and geographical coverage. The available evidence therefore represents the distribution of documented records rather than the full distribution of edible-flower traditions in Nepal.

Figure 1. Locations of studies documenting traditional edible-flower consumption in Nepal



Note: Locations indicate districts where traditional edible-flower consumption has been documented in published ethnobotanical studies. They represent study locations, not the geographical distribution of the 15 edible-flower species.

5.2 Community-specific knowledge: Several studies provide evidence of community-specific edible-flower knowledge. Among Raji communities in western Nepal, documented floral resources included *Justiciaadhatoda*, *Bauhinia* variegata, *Rhododendron arboreum*, and *Woodfordiafruticosa* (Thapa et al., 2014), with uses ranging from pickle preparation and raw consumption to the direct consumption of flower juice. Among Chepang communities in Gorkha and Tanahun, *Bauhinia* variegate and *Girardiniadiversifolia* were documented as food resources involving floral parts (Limbu & Thapa, 2011). Tharu-associated records included *Dilleniapentagyna* (Agaie) and *Madhucalongifolia* (Mahuwa) in the study areas reported by Uprety et al. (2012). These records demonstrate that edible-flower knowledge occurs within specific local and community contexts. They should not be generalized to entire ethnic groups or regions beyond the populations documented in the original studies.

5.3 Ecology, culture and food knowledge: The available evidence suggests that edible-flower use reflects an interaction between local plant availability and culturally transmitted food knowledge. Access to floral resources provides opportunities for consumption, but their recognition and use as food also depend on knowledge of which floral parts are consumed and how they are prepared. The variation documented among Raji, Chepang, Tharu and other study populations therefore supports viewing edible-flower use as a form of place-based food knowledge shaped by both ecological availability and cultural practice. However, the available literature is insufficient to establish direct causal relationships between particular ecological settings and culinary traditions.

6. Documentation Gaps and Research Priorities

6.1 Evidence and documentation gaps: The literature contains confirmed, candidate and ambiguous edible-flower records. Confirmed records explicitly link a floral structure to culinary

use in Nepal, whereas candidate or ambiguous records lack sufficiently clear or traceable evidence. This distinction is particularly important in broader wild edible plant (WEP) inventories, where classification of a species as edible does not necessarily indicate that its flowers are consumed. The 15 confirmed species therefore represent a conservative documented baseline rather than an exhaustive inventory. Additional species may be confirmed through further examination of primary sources and field-based ethnobotanical research.

6.2 Geographic and cultural gaps: Existing edible-flower records are geographically uneven and largely reflect the locations in which ethnobotanical research has been conducted. This corresponds with broader Nepalese WEP research, which has documented records from 52 of 77 districts and identified substantial geographical differences in research effort (Chaudhary et al., 2025). Absence of published records should therefore not be interpreted as absence of edible-flower traditions. Cultural documentation is similarly limited. Existing studies often identify the species, plant part and general use but provide less information on who collects, prepares and consumes the flowers, how frequently they are consumed, and how this knowledge is transmitted. Community-specific practices should consequently not be generalized beyond the populations and locations studied.

6.3 Priorities for future documentation: Future research should prioritize community-level ethnobotanical surveys in poorly documented regions and communities. Studies should record the botanical identity and voucher specimen, precise floral part consumed, local name, locality and community, preparation method, seasonality, frequency and current status of use. Particular attention should also be given to knowledge transmission, including who holds edible-flower knowledge, how it is learned, and whether documented foods remain actively consumed or are primarily remembered practices. Such standardized documentation would improve the verification and comparability of future records while preserving their cultural context.

7. Conclusion

Edible flowers constitute a distinct but insufficiently synthesized component of Nepal's traditional food biodiversity. Although floral food-use records are scattered across ethnobotanical and wild-edible-plant studies, this review demonstrates that flowers and other floral structures have an identifiable place within Nepal's documented traditional food systems. Using conservative inclusion and verification criteria, 15 species belonging to 14 genera and 10 families were identified with explicit Nepal-based evidence of culinary use of flowers, flower buds or floral nectar. These species constitute a confirmed core inventory rather than an exhaustive account of Nepal's edible-flower diversity. This distinction is important because the inclusion of a species in a wild-edible-plant inventory does not necessarily establish consumption of its floral parts. The documented uses were diverse, including flowers and buds consumed as vegetables and pickles, raw or fresh flowers, directly consumed floral nectar or juice, and flowers used in alcoholic preparations. Community-specific records among Raji, Chepang and Tharu study populations further indicate that edible-flower use is embedded within particular local and cultural contexts. However, the evidence remains geographically and culturally uneven, reflecting differences in research effort and ethnobotanical documentation as well as potentially underlying variation in food traditions. Additional edible-flower practices may therefore remain undocumented or insufficiently represented in the published literature. Future research should prioritize community-

level documentation in underrepresented regions, with careful recording of botanical identity, floral parts consumed, local names, preparation methods, seasonality, frequency of use and knowledge transmission. The present inventory provides a minimum documented baseline from which Nepal's edible-flower knowledge can be further investigated as part of the country's broader biocultural food heritage.

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13. *Therefore POWO needs a reference-list entry, with an access date according to the eventual journal's format.*

पुष्प खेतीमा हाइड्रोजन पेरोक्साइडको उपयोग: एक समिक्षात्मक अध्ययन

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सचिव, बागमती प्रदेश सरकार, कृषि, पशुपक्षी, वन तथा वातावरण मन्त्रालय, हेटौंडा

परिचय

हाइड्रोजन पेरोक्साइड (H_2O_2) सर्वप्रथम सन् १८१८ मा फ्रान्सेली रसायनशास्त्री लुइस ज्याक थेनार्डले पत्ता लगाएका थिए । यो एक रासायनिक पदार्थ हो जसलाई पानी (H_2O_2) सँग तुलना गर्दा यसमा पानीमा भन्दा थप यौटा अतिरिक्त अक्सिजन अणु रहेको हुन्छ । हाइड्रोजन पेरोक्साइडलाई प्रयोग गरेपछि यो पानी र अक्सिजनमा विच्छेदित हुन्छ, र यसबाट निस्कने अक्सिजनले अन्य जैविक र अजैविक अणुहरूलाई अक्सिडेशन गर्दछ । साथै, यसबाट उत्पन्न भएको अक्सिजन जीवकोषमा विभिन्न मेटाबोलिक प्रक्रियाहरूमा सक्रिय रूपमा संलग्न हुन्छ, जसले कोशिकाका कार्यहरूमा महत्वपूर्ण परिवर्तनहरू ल्याउँछ । यसलाई वातावरणमैत्री अक्सिडाइजिङ एजेण्ट पनि भन्न सकिन्छ किनभने यसले वातावरणमा कुनै पनि हानिकारक अवशेष छाड्दैन र छिटै पानी र अक्सिजनमा परिणत हुन्छ । हाइड्रोजन पेरोक्साइडलाई जीवाणुनाशकको रुपमा प्रयोग गर्न सकिने तथ्य पहिलो पटक सन् १८९१ मा बेन्जामिन वार्ड रिचर्डसन् नामक बेलायती बैज्ञानिकले पत्ता लगाएका थिए । अहिले यसलाई व्यापक रूपमा एण्टिसेप्टिक (विशेषगरी घाउमा), दाँतको disinfectant र अन्य सतह तथा सम्पर्क disinfectant रूपमा प्रयोग गरिन्छ । वातावरणमैत्री भएको कारण यसको प्रयोग ब्यापकरुपमा खाद्य उद्योगहरु, विशेष गरी फलफूल सफा गर्नको लागि र खानेपानी शुद्धिकरणको लागि हुने गरेको छ । हाइड्रोजन पेरोक्साइड प्राकृतिकरुपमा पनि पृथ्वीको वायुमण्डल, जीव र वनस्पति जताततै पाइन्छ । वनस्पतिहरूमा, यो प्रकाश संश्लेषण, फोटोरेस्पिरेशन, फ्याटी एसिड अक्सीडेसन, र माइटोकन्ड्रियामा हुने इलेक्ट्रोन ट्रान्सपोर्टको क्रममा उत्पादन हुन्छ । हानीकारक शुक्ष्म जीवाणुहरुलाई नियन्त्रण गर्ने र विरुवाको प्रतिरोध प्रणाली बृद्धि गर्ने क्षमता एवं बोटको बृद्धिमा सहयोग गर्ने भएको कारण कृषि क्षेत्रमा आजभोलि हाइड्रोजन पेरोक्साइडको प्रयोग निकै बढ्न थालेको छ ।



चित्र नं. १. नेपाली बजारमा उपलब्ध सिल्भर हाइड्रोजन पेरोक्साइडका ब्यवसायिक उत्पादनहरु

विरुवामा हाइड्रोजन पेरोक्साइडले पार्ने प्रभाव

हाइड्रोजन पेरोक्साइड बिरुवाको लागि निकै महत्वपूर्ण हुन्छ किनभने यसले बिरुवाको मेटाबोलिजम र तनाव (स्ट्रेस) ब्यवस्थापनमा मूख्य भूमिका खेल्दछ । यसले कोषको भित्ता (cell wall) लाई मजबुत बनाउन सहयोग गर्दछ जसले बिरुवालाई जीवाणुको आक्रमणलाई प्रतिरोध गर्न मदत गर्दछ । यसले बिरुवामा अक्जिन जस्तो कोषको विकास र बृद्धिलाई नियन्त्रण गर्ने हर्मोनको उत्पादनमा सहयोग पुऱ्याउँछ । Jamaludin et al. (2020) द्वारा डेल्टा फिग (*Ficus deltoidea*) मा गरिएको एक अध्ययन अनुसार हाइड्रोजन पेरोक्साइडको 20 mM घोल (६८०.२ पि.पि.एम) घोलले उपचार गर्दा उक्त प्रजातिको बिरुवाको उचाई, कूल प्रकाश संश्लेषण दर, स्टोमाटाको सकृयता र बिरुवामा हरितकणको मात्रामा उपचार नगरिएको बिरुवाको तुलनामा क्रमशः १०%, २०%, १२७% र ५७% बृद्धि भएको पाइयो । साथै उक्त प्रयोगबाट क्यारोटिन, कूल फेनोलिक र फ्लाभेनोइड एवं सुगरको मात्रामा उपचार नगरेकोमा भन्दा बृद्धि भएको पाइयो ।

शुक्ष्म जीवाणुहरुमा हाइड्रोजन पेरोक्साइडले पार्ने प्रभाव

हाइड्रोजन पेरोक्साइडको कडा अक्सिडेटिभ प्रकृतिको कारण ब्याक्टेरिया, भाइरस र ढुसीको संक्रमणको बिरुद्ध यसलाई प्रयोग गर्न सकिने कुरा थुप्रै अध्ययनहरुबाट प्रमाणित भइसकेको छ । यसले जीवाणुको कोषमा अक्सिडेटिशन गराउँछ जसले गर्दा जीवाणुको कोषको प्रोटिनलाई बिच्छेदित गर्नुका साथै कोषभित्तामा क्षति पुऱ्याउँछ । हाइड्रोजन पेरोक्साइडको अणुको आकार निकै सानो हुने भएकोले यो सजिलै जीवाणुको कोषभित्र छिर्न सफल हुन्छ र त्यसलाई नष्ट गर्दछ । एक अध्ययन अनुसार हाइड्रोजन पेरोक्साइडको थोरै मात्रा (३%) ले ब्याक्टेरियाको कोशिकामा संरचनात्मक परिवर्तन गरेको पाइयो भने बढी मात्रा (१०-३०%) ले ब्याक्टेरिया र ढुसीलाई नै नष्ट गरेको पाइयो *(Brandi et al., 1991)* ।

निर्मलिकरणको कार्यमा हाइड्रोजन पेरोक्साइडको प्रयोग

हाइड्रोजन पेरोक्साइडको प्रयोग खानेपानी वा सिंचाईको पानीलाई शुद्धिकरणमा, ग्रीनहाउसमा प्रयोग हुने औजार उपकरणको निर्मलिकरणमा ब्यापकरुपमा हुने गरेको छ । यसले पानी तथा औजार उपकरणमा हुने शुक्ष्म जीवाणुहरुलाई निस्कृय बनाउन मदत गर्दछ । यसैगरी प्याकेजिङ हाउस तथा स्टोर हाउस र प्लाष्टिक टनेल एवं ग्रीनहाउसको निर्मलिकरणमा समेत यसको प्रयोग गर्न सकिन्छ । हाइड्रोजन पेरोक्साइडको ३ देखि ६% को घोलले पटिङ मिश्रण र बेर्नाहरुलाई जीवाणुको संक्रमणको मात्रा र किसिम अनुसार १० देखि १० घण्टासम्म धुवाउँदा निकै प्रभावकारी ढङ्गले निर्मलिकरण भएको पाइएको छ (Orlikowski et al. 2023) । पटिङ मिश्रणहरुको पुनः प्रयोग गर्नु अघि हाइड्रोजन पेरोक्साइडले उपचार गरेमा निर्मलिकरणको साथै मिश्रणमा भएको कीटनाशक र झारनाशक विषादीको अवशेषलाई समेत नष्ट गर्न सक्ने देखिएको छ (Newan, 2004) । Barta and Henderson (2000) को एक अध्ययनले हाइड्रोपोनिक प्रणालीमा हाइड्रोजन पेरोक्साइडको ०.५% घोललाई परम्परागत ब्लिचिङको सोलुशनको बिकल्पमा प्रयोग गर्न सकिने र जीवाणुको संक्रमणलाई झण्डै शुन्यमा झार्न सकिने देखाएको छ ।

बाली रोग नियन्त्रणमा हाइड्रोजन पेरोक्साइडको प्रयोग

हाइड्रोजन पेरोक्साइडको प्रयोगबाट थुप्रै रोगहरुको नियन्त्रण गर्न सकिने तथ्य थुप्रै शोधकर्ताहरुको शोधपत्रहरुबाट सिद्ध भइसकेको छ । Mannion et al. (2023) को अध्ययन अनुसार १-हाइड्रोक्सिइथिलिडाइन १-डाइफोस्फोनिक एसिड (HEDP) सँग संमिश्रण गरिएको हाइड्रोजन पेरोक्साइडले *Phytophthora cinnamomi* नामको बालीहरुमा जरा, गला र काण्डको सडन रोग पैदा गराउने ढुसीलाई प्रभावकारी ढङ्गले नियन्त्रण गर्न सक्ने पाइएको छ । उक्त अध्ययनमा ६.२५ मि.लि. प्रति लिटरको हाइड्रोजन पेरोक्साइड ३% HEDP सँग मिसाएर प्रयोग गर्दा उक्त ढुसी शतप्रतिशत नियन्त्रण भएको पाइयो । हाइड्रोजन पेरोक्साइड थुप्रै ढुसीजन्य जीवाणुहरु जस्तै, काँक्रोफर्सी जातको डाउनी मिल्ड्यू (Kuepper, 2003), आलुको पछौडे डढुवा (Kuepper and Sullivan, 2004), र स्याउको दादेरोग (Phillips, 2005) आदिमा निकै प्रभावकारी भएको पाइएको छ ।

बिरुवाको बृद्धिबर्धकको रुपमा हाइड्रोजन पेरोक्साइडको प्रयोग

हाइड्रोजन पेरोक्साइडले बिरुवाको प्रतिरोध क्षमतासँग सम्बन्धित वंशाणुलाई सकृय बनाउने कार्यमा भाग लिन्छ । बिरुवामा जीवाणुले संक्रमण गरेको र क्षति पुगेको स्थानमा प्राकृतिक रुपमा नै हाइड्रोजन पेरोक्साइडको मात्रा बृद्धि भएको पाइयो जसले जीवाणुसँग लड्न र घाउ छिटै पुर्न मदत पुग्ने देखियो (Orozco-Cárdenas et al. 2001) । Webber and Sandtner (2007) ले गरेको एक अध्ययनमा हाइड्रोजन पेरोक्साइड पातमा स्प्रे गर्दा र माटोमा प्रयोग गर्दा बादलपाते फूल (Nasturtium) को जरा मजबुत भएको र फूलको संख्यामा पनि बृद्धि भएको पाइयो ।

पोष्टहार्भेष्ट आयु बृद्धि गर्नको लागि हाइड्रोजन पेरोक्साइडको प्रयोग

हाइड्रोजन पेरोक्साइडलाई तरकारी, फलफूल र फूलहरुको पोष्टहार्भेष्ट आयु बृद्धि गर्नको लागि पनि प्रयोग गर्न सकिन्छ । यसलाई फलफूल र तरकारीको सतहमा हुने शुक्ष्मजीवाणुलाई नष्ट गर्ने कार्यमा प्रयोग गरिन्छ भने फूलको डाँठ डुबाउने भास सोलुशनमा मिसाएर पनि प्रयोग गर्न सकिन्छ । रजनीगन्धा कटफ्लावरको मूख्य पोष्ट हार्भेष्ट समस्या भनेको फूलको पुष्पदलहरु ओइलाउनु र डढेजस्तो देखिनु र फूलको डाँठको टुप्पा बाँगिनु आदि हुन् । यसले रजनीगन्धाको भास लाइफ (फूलदानीमा टिक्ने समय) घटाउँछ (Jowkar and Salehi, 2005) । Rahimian-Boogar et al. (2016) ले गरेको एक अनुसन्धान अनुसार हाइड्रोजन पेरोक्साइडको २० पि.पि.एम. को घोललाई रजनीगन्धा फूलको भास सोलुशनको रुपमा प्रयोग गर्दा फूलको पुष्पदल ओइलिने र झर्ने प्रकृया, फूलमा पानी र हरितकणको मात्रा तथा भास लाइफमा सकारात्मक प्रभाव परेको देखियो । उपचार नगरिएको फूलको भास लाइफ ८ दिन जति भएकोमा उपचार गर्दा भास लाइफ दोब्बरसम्म भएको पाइयो । यसैगरी Liao et al. (2012) ले लिली फूलमा गरेको अनुसन्धानले २० पि.पि.एम. हाइड्रोजन पेरोक्साइड भास सोलुशनको रुपमा प्रयोग गर्दा भास लाइफ उपचार नगरेकोमा ९.८ दिनबाट बृद्धि भई १२.८ दिन पुगेको पाइयो ।

बीउ र गानोको सुशुप्तावस्था तोड्न र बीउको अंकुरण बढाउन हाइड्रोजन पेरोक्साइडको प्रयोग

हाइड्रोजन पेरोक्साइडको घोलमा केही समय बीउ वा गानोलाई भिजाएर राख्दा गानोको शुसुप्तावस्था तोड्न सकिने र बीउको अंकुरण क्षमता बढाउन सकिने देखिएको छ । हाइड्रोजन पेरोक्साइडमा भएको अतिरिक्त अक्सिजनले बीउको अंकुरणमा मदत गर्दछ । माटोमा हावा संचार कम हुनु, तामा अर्थात कपरको मात्रा अधिक हुनु, तापक्रम बढी वा साह्रै न्यून हुनु तथा माटोमा लवणको मात्रा बढी हुनु (high salinity) आदि कारणबाट बीउको उमारशक्तिमा नकारात्मक असर पर्दछ । हाइड्रोजन पेरोक्साइडको प्रयोगले यस्ता समस्याहरुको समाधान गर्न सकिन्छ (Rajashekar and Baek, 2014; Wen et al., 2013; Sathiyaraj et al., 2014) . Szopińska (2014) को अध्ययनले जिनिया फूलको बीउलाई ६ देखि ९ प्रतिशतको हाइड्रोजन पेरोक्साइडको घोलमा २० देखि ६० मिनेटसम्म भिजाएर रोप्दा ढुसीनाशक विषादीले उपचार गरेकोमा भन्दा बीउको उमारशक्ति राम्रो भएको र बेर्नामा ढुसीको संक्रमण कम भएको देखायो ।

माटोमा हाइड्रोजन पेरोक्साइडले पार्ने प्रभाव

चिम्ट्याइलो खालको माटोमा पानीको निकास कम हुने हुनाले यस्तो अवस्थामा जरामा अक्सिजनको कमी हुन सक्दछ । यस्तो अवस्थामा सिंचाईको पानीसँग हाइड्रोजन पेरोक्साइड मिसाउँदा जराले अक्सिजन प्राप्त गर्दछ र क्षति कम गराउन सकिन्छ (Melstead et al., 1949; Bryce et al., 1982) । Bhattarai et al. (2004) का अनुसार जुकुनी फर्सीमा खेतमा गरिएको परिक्षण तथा कपास र भटमासमा गमलामा गरिएको परिक्षणमा चिम्ट्याइलो माटोमा हाइड्रोजन पेरोक्साइडको माध्यमबाट अक्सिजन आपुर्ति गर्दा उत्पादनमा उल्लेखनीय बृद्धि भएको पाइयो । गमलामा हुर्काइएको बिरुवाहरुमा ५०% हाइड्रोजन पेरोक्साइड १ मि.लि/लिटर पानीमा मिसाएर सिंचाई गर्दा सोको सकारात्मक नजिता पाइएको छ (Bhattarai, 2005) ।

हाइड्रोजन पेरोक्साइड र नानो सिल्भर: शुक्ष्म जीव नियन्त्रणमा संयुक्त प्रभाव

सिल्भर अर्थात चाँदीको प्रयोग मानव सभ्यतामा परापूर्वकालदेखि हुँदै आएको छ । यसको प्रयोग गहना निर्माणको लागि मात्र नभएर स्वास्थ्य र सरसफाईको क्षेत्रमा समेत भइरहेको छ । परम्परागत हिन्दु औषधी विज्ञानमा चाँदीलाई

विभिन्न रोगहरुको उपचार गर्न एक औषधीय तत्वको रुपमा चित्रित गरिएको छ । सिल्भरले ष्यल र नानो कण (< १०० नानो मिटर) दुवै प्रकारको स्वरुपमा जीवाणुलाई मार्न सक्दछ (Lara et al., 2011) । हाइड्रोजन पेरोक्साइड र नानो-सिल्भरले संयुक्तरुपमा हावा, पानी र माटोमा रहेका विभिन्न प्रकारका सूक्ष्मजीवलाई प्रभावकारी रूपमा मार्दछ र यसले शक्तिशाली एन्टिबायोटिक, ढुसीनाशक, भाइरसनाशक, अमिवानाशक र अल्गीनाशकको रूपमा काम गर्छ । Shuval et al. (2009) का अनुसार नानो सिल्भर मिश्रित हाइड्रोजन पेरोक्साइड जीवाणुनाशकको रुपमा एक्लो हाइड्रोजन पेरोक्साइड मात्र भन्दा १०० गुना बढी प्रभावकारी हुन्छ । Durán et al. (2016) एवं Mufamadi and Mulaudzi (2019) का अनुसार नानो सिल्भरका शुक्ष्म कणहरुमा ऋणात्मक चार्ज हुन्छन् जसले धनात्मक चार्ज भएका ब्याक्टेरियाका कोषभित्ताहरुसँग प्रतिकृया गर्दछ र ती भित्ताहरुमा छिद्र बनाउँछ र भित्र प्रवेश गर्दछ, ब्याक्टेरियाको डि.एन.ए.सँग मिसिन्छ र त्यसलाई नष्ट गर्दछ । त्यसैगरी Yamanaka et al. (2005) का अनुसार सिल्भर आयनहरुले ब्याक्टेरियाको राइबोजोमसँग अन्तरकृया गर्दछ र ATP संश्लेषणको लागि आवश्यक पर्ने इन्जाइम र प्रोटिनको उत्पादनमा अवरोध गर्दछ, फलस्वरुप यसले ब्याक्टेरियामा ATP को कमी गराउँदछ । भाइरसको हकमा नानो सिल्भरले भाइरसको न्युक्लिक एसिडको बृद्धि हुनबाट रोक्दछ (Gupta et al. 2018) ।

नानो सिल्भरको एकल प्रभाव

थुप्रै अनुसन्धान रिपोर्टहरुले नानो सिल्भरलाई स्वतन्त्ररुपमा प्रयोग गर्दा पनि यसले बिरुवाको बृद्धि गराउन, तनाव कम गर्न र रोगको जीवाणु बिरुद्ध लड्न सहयोग पुऱ्याउने तथ्य सावित गरेका छन् । सिल्भरका नानो कणहरु बिरुवाका पात वा जराको कोष भित्तामा रहेका छिद्रहरू मार्फत कोषभित्र प्रवेश गर्दछ र साइटोप्लाजम् हुँदै कोषका अङ्गहरुको मेटाबोलिजलाई हस्तक्षेप गर्दछ । त्यसपछि जाइलमको माध्यमबाट यो बोटको सबै भागमा यात्रा गर्छ (Yan and Chen, 2019) । Salachna et al. (2019) का अनुसार नानो सिल्भरको घोलमा लिली फूलका बल्बहरु डुबाउनाले बिरुवाको बृद्धि राम्रो गर्नुका साथै फूलको संख्यामा र फूल फूल्ने अवधिमा समेत बृद्धि गरेको पाइयो । नानो सिल्भरलाई पोष्टहार्भेष्टमा प्रयोग गर्दा लिली, लिसियान्थस, गुलाब र कार्नेशन जस्ता फूलहरुको आयु र गुणस्तर सुधार गर्न सकिन्छ । नानो सिल्भरले फूलदानीको पानी र फूलका मुन्टोमा रहेका ब्याक्टेरियाहरूलाई मार्दछ, जाइलममार्फत यात्रा गरेर यसले इथिलिनको उत्पादन घटाउँछ । यसले उपचार गर्दा फूलमा पानीको मात्रा, ताजा फूलको तौल, र एन्टिआक्सिडन्टको गतिविधिमा सुधार ल्याउँछ (Naing and Kim, 2020) । नानो सिल्भरको प्रयोग टिस्युकल्चर प्रविधिबाट उत्पादन गरिने बिरुवाहरुमा पनि ब्यापकरुपमा हुने गरेको छ । Sharma et al. (2022) ले पारिजातको टिस्युकल्चर बिरुवा उत्पादन गर्दा ६ पी.पी.एम. नानो सिल्भर तरल वा अर्धतरल कल्चर मिडियामा प्रयोग गरेमा बृद्धिदर १.२९ बाट २५.१७ सम्म हुने, बिरुवाको बृद्धिदर बढ्ने र जीवितदर ८०% सम्म हुनसक्ने कुरा पत्ता लगाएका थिए । त्यसैगरी Jadczak et al. (2020) ले नानो सिल्भरको २ र ५ पि.पि.एम. मात्राले लाभेण्डरको टिस्युकल्चर बिरुवा उत्पादन गर्दा एन्टिअक्सिडेन्ट इन्जाइम गतिबिधि, फ्रि-याडिकलहरुको निस्कृयकरण र पोलिफेनोलको उत्पादनमा बृद्धि हुने कुरा पत्ता लगाएका थिए ।

कार्नेशन, गुलाफ, जिप्लोफिला जस्ता कतिपय कटफ्लावरहरुको पोष्ट हार्भेष्टसम्बन्धी मूख्य समस्याहरुमध्ये इथिलिन ग्याससँग यी फूलहरु अलि बढी संवेदनशील हुनु पनि एक हो । इथिलिन ग्यासले यी फूलहरुमा पुष्पदल झर्ने वा खैरो हुने समस्या उत्पन्न गर्छ, जसले फूलको गुणस्तरलाई गम्भीर रूपमा घटाउँछ र बजारमा बिक्रीको लागि अयोग्य बनाउँछ । नानो सिल्भरले कट फ्लावरहरुको पोष्ट हार्भेष्ट क्षति कम गर्न दोहोरो भूमिका खेल्दछ । एकातिर यसले एन्टिब्याक्टेरियल एजेण्टको कार्य गरी ब्याक्टेरियाको संख्या कम गर्न मदत गर्दछ भने अर्कोतर्फ इथिलिनको उत्सर्जनलाई अवरोध गर्दछ । कार्नेशनमा सिल्भर थायोसल्फेट (STS) को प्रयोग गरेर पोष्टहार्भेष्ट आयु बढाउने तरीका पहिलेदेखि नै चलिआएको छ । सिल्भर थायोसल्फेटद्वारा उपचार गरिएका कार्नेशन कट फ्लावरहरूमा इथिलिन उत्पादनको वृद्धि रोकिन्छ र फूलको वृद्धावस्था (senescence) ढिलो हुने गर्दछ (Reid et al., 1980) । कार्नेशनमा नानो सिल्भरलाई एन्टिइथिलिन एजेण्टको रुपमा प्रयोग सर्वप्रथम Koohkan et al., (2014) ले गरेका थिए । उनीहरुको अनुसन्धान अनुसार ५ मि.ग्रा./लि. अर्थात ५ पि.पि.एम. को नानो सिल्भरको घोलमा कार्नेशनका काटिएका डाँठहरु डुबाएर राख्दा सबैभन्दा बढी पोष्ट हार्भेष्ट आयु (vase life) र सबैभन्दा

कम इथिलिन उत्सर्जन भएको पाइयो । ५ मि.ग्रा./लि. को घोलमा उपचार गरिएका कार्नेशनका डाँठ र पातहरुमा सिल्भरको मात्रा उपचार नगरिएका र ५ मि.ग्रा./लि. भन्दा बढी मात्रामा प्रयोग गरिएको उपचारभन्दा बढी भएको पाइयो । यसैगरी Naing et al. (2017) द्वारा गरिएको अनुसन्धानमा भने २५ मि.ग्रा./लि. को नानो सिल्भरको घोल कार्नेशनको पोष्टहार्भेष्ट आयु बढाउन सबैभन्दा प्रभावकारी भएको पाइयो ।

यसैगरी जरबेरा फूलको मूख्य पोष्टहार्भेष्ट समस्या भनेको डाँठ बाँगिनु (stem bending) हो । यो समस्याको प्रमुख कारणहरु मध्येको एक भनेको फूलको जाइलम नलीहरु (xylem vessels) लाई शुक्ष्म जीवाणुहरुले अबरुद्ध पार्नु हो (Marandi et al., 2011) । जरबेरा फूलको पोष्टहार्भेष्ट आयु बढाउन र डाँठ बाँगिने समस्या कम गर्न विभिन्न पदार्थहरुको प्रयोग गर्ने गरिएको छ । Solgi et al. (2009) ले दिएको रिपोर्ट अनुसार जरबेरालाई नानो सिल्भरद्वारा पूर्व-उपचार (pre–treatment) गर्दा जीवाणुको संक्रमण कम गर्न निकै प्रभावकारी भएको थियो । जरबेरा कट फ्लावरको आयु (vase life) नानो सिल्भर ५ मि.ग्रा./लि. र ६% सुक्रोजको मिश्रित घोलमा २४ घण्टाको लागि उपचार गर्दा सिल्भर नाइट्रेट वा 8-HQC (8-hydroxyquinoline citrate) मा उपचार गरेको र उपचार नगरेको तुलनामा उल्लेखनीय रुपमा बढी भएको पाइयो । यसैगरी Liu et al. (2009) ले गरेको अध्ययनमा समेत जरबेराको डाँठलाई नानो सिल्भर ५ मि.ग्रा./लि. को घोलमा २४ घण्टाको लागि डुबाउँदा उपचार नगरेकोमा भन्दा फूलको आयु बढी भएको पाइएको छ ।

गोदावरी फूलको प्रमुख पोष्ट हार्भेष्ट समस्याहरुमा पातहरु पहेंलिने, ओइलाउने र फूल राम्रोसँग नखुल्ने आदि हुन् । यस समस्यालाई समाधान गर्नको लागि प्रयोग गरिने पोष्ट हार्भेष्ट प्रविधिहरू मध्ये पल्सिङ (pulsing) घोलको प्रयोग पनि एक हो । पल्सिङ घोलको रुपमा सिल्भर नाइट्रेट वा जिङ्क अक्साइडको प्रयोग हुँदै आएकोमा Prabawati et al. (2023) ले तिनीहरुको बिकल्पमा नानो सिल्भर २० मि.ग्रा./लि. (२० पि.पि.एम.) प्रयोग गर्दा सिल्भर नाइट्रेट प्रयोग गरेकोमा भन्दा पोष्ट हार्भेष्ट आयु ४ दिनले बढी र उपचार नगरेको तथा जिङ्क अक्साइड प्रयोग गरेकोमा भन्दा १९ दिनले बढी भएको पाइयो ।

लिली फूलको विविध आकार र रङ्गको कारणले कट फ्लावरको बजारमा यसको विशेष स्थान छ । तर यसको असाध्यै छोटो पोष्ट हार्भेष्ट आयु हुनु यसको बजारिकरणमा प्रमुख समस्याको रुपमा रहेको छ । यस्तो अवस्थामा Nemati S. et al. (2013) ले गरेको एक अध्ययन अनुसार नानो सिल्भरको ३० पि.पि.एम. घोलमा लिली फूलको डाँठहरुलाई डुबाएर राख्दा उपचार नगरेको (६.५ दिन) भन्दा झण्डै दोब्बर (११.३ दिन) समयसम्म ताजा राख्न सकिने देखिएको छ ।

कट फ्लावरहरुमध्ये गुलाफको स्थान पहिलो नम्बरमा मानिन्छ । तर गुलाफको पोष्ट हार्भेष्ट आयु बढीमा एक हप्ताजति मात्र हुनु यसको बजारिकरणको प्रमुख समस्या हो । गुलाफको पोष्ट हार्भेष्ट समस्याहरुमध्ये काटिएका डाँठहरुले पानीको अवशोषण परिचालन कम गरेको कारण उत्पन्न हुने विभिन्न समस्याहरु जस्तै फूलको डाँठ मोडिनु, पात र फूल ओइलाउनु आदि हुन् । गुलाफ इथिलिन ग्यास प्रति अलि बढी संवेदनशील पनि मानिन्छ । गुलाफलाई इथिलिन उत्सर्जन हुने स्थानमा भण्डार गरेमा फूल ओइलाउने र मर्ने प्रकृया बढी हुन्छ । गुलाफमा सिल्भर थायोसल्फेट जस्ता सिल्भरयुक्त प्रिजर्भेटिभहरुको प्रयोग पोष्टहार्भेष्ट क्षति न्यून गर्नको लागि प्रयोग हुँदै आएकोमा सिल्भर थायोसल्फेटलाई वातावरणीय प्रदुषणको कारक र मानवस्वास्थ्यको लागि हानिकारक मानिएको छ । यस्तोमा सिल्भर थायोसल्फेटको बैकल्पिक प्रिजर्भेटिभको खोजी भइरहेको सन्दर्भमा नानो सिल्भर (NS), अल्फा एमिनो आइसोब्युटाइरिक एसिड (A) र १-मिथाइल साइक्लोप्रोपिन (M) को घोल (NS+AM) मा गुलाफको डाँठलाई डुबाएर २४ घण्टासम्म इथिलिन ग्यास भएको ठाउँमा राख्दा उपचार नगरेको गुलाफमा भन्दा पोष्टहार्भेष्ट आयु १६८-२१७% सम्म बृद्धि गर्न सकिने देखिएको छ (Ha and In, 2022) ।

नानो सिल्भरलाई कट फ्लावरहरुको भास लाइफ बढाउन पल्सिङ सोलुशनको रुपमा प्रयोग गर्नु पर्दा सामान्यतया ५ देखि २० पि.पि.एम. को घोलमा फूल टिपेपछि काटिएका डाँठहरुको मुठालाई कम्तीमा २४ घण्टाको लागि डुबाएर राख्न सिफारिस गर्न सकिन्छ ।

नानो सिल्भर र हाइड्रोजन पेरोक्साइडको संयुक्त प्रभाव

नानो सिल्भर र हाइड्रोजन पेरोक्साइडको संयुक्त र प्रभावकारी असरको अनुसन्धान Alkawareek et al. (2019) द्वारा गरिएको छ । उनीहरुले के पत्ता लगाए भने यी दुई तत्वहरुलाई संयुक्तरुपमा प्रयोग गर्दा सापेक्षिकरुपमा कम मात्रा र छोटो अवधिको प्रयोगमा पनि यसले Escherichia coli (ग्राम-निगेटिभ) र Staphylococcus aureus (ग्राम-पोजिटिभ) दुबै खालका ब्याक्टेरियाहरुलाई पूर्णरुपमा नष्ट गर्न सक्षम भए, जसले तिनीहरूको संयुक्त प्रभावलाई प्रमाणित गऱ्यो । त्यस्तै Wojdyła et al. (2025) ले गरेको अनुसन्धानमा सिल्भर मिश्रित हाइड्रोजन पेरोक्साइडको २-३% घोलमा गुनकेशरीको गानोलाई २० मिनेटको लागि डुबाउँदा बिरुवाको बृद्धि र विकासमा सहयोग गर्नुका साथै फूलहरुको संख्या, फूलको आकार र अरु बृद्धिसँग सम्बन्धित विशेषताहरु उपचार नगरेका गानोहरुको तुलनामा उल्लेखनीयरुपमा बढी भएको पाइयो । जलकुम्भी फूल (Hyacinth) को गानोहरुलाई सिल्भर हाइड्रोजन पेरोक्साइडको २-१०% घोलमा २० मिनेटको लागि डुबाउनाले गानोमा ढुसीजन्य आक्रमणलाई कम गर्नुका साथै बिरुवाको बृद्धि, बायोमास र फूल फूल्ने गुणहरुमा सुधार भएको पाइएको छ (Wojdyła et al., 2022) ।

Mahesha et al. (2021) ले नानो सिल्भर हाइड्रोजन पेरोक्साइडको ब्यवसायिक उत्पादन, Alstasan Silvox® को बिरुवाहरुमा रोग लगाउने विभिन्न जीवाणुहरु विरुद्धको एन्टिमाइक्रोबियल क्षमताको मूल्याङ्कन गरेका छन् । यो ब्यवसायिक उत्पादनमा नानो सिल्भर ५०० पि.पि.एम र हाइड्रोजन पेरोक्साइड ४८-५०% मिसाइएको हुन्छ । उक्त अध्ययनमा अदुवाको इन-भिट्रो बिरुवा उत्पादन गर्दा सिल्भर हाइड्रोजन पेरोक्साइडले Xanthomonas axonopodis pv. citri, Xanthomonas citri pv. punicae, / Ralstonia solanacearum जस्ता ब्याक्टेरियाहरुका साथै माटोमा हुने ढुसी Pythium aphanidermatum / Fusarium solani विरुद्ध प्रभावकारी एन्टिमाइक्रोबियल असर देखाएको थियो । यो ब्यवसायिक उत्पादन Alstasan Silvox® हाल नेपाली बजारमा समेत उपलब्ध छ ।

नानो सिल्भर मिश्रित हाइड्रोजन पेरोक्साइडले बागबानीजन्य बोटबिरुवाहरु खासगरी आलङ्कारिक बिरुवाहरुलाई विभिन्न रोगहरुबाट सुरक्षा प्रदान गर्न सक्ने कारण यसप्रति धेरैको ठूलो चासो उत्पन्न हुन थालेको छ । Wojdyła (2012, 2016a, b) बाट गरिएको अध्ययनहरुबाट Cissus, Geranium, Willow, र Rose जस्ता बिरुवाहरूमा ०.०५% र ०.१% हाइड्रोजन पेरोक्साइडको घोलको नियमित स्प्रे गर्दा पाउडरी मिल्ड्यू, ब्ल्याक स्पट, र सिन्दुरे जस्ता रोगहरूबाट बच्न सकिने देखिएको छ । उक्त अध्ययनहरुमा हाइड्रोजन पेरोक्साइडको प्रभावकारिता ६०%-९० % सम्म रहेको थियो ।

नेपालमा सिल्भर/हाइड्रोजन पेरोक्साइडको प्रयोग सम्बन्धी अध्ययन अनुसन्धानहरु

नेपालमा हाइड्रोजन पेरोक्साइड वा सिल्भर मिश्रित हाइड्रोजन पेरोक्साइडको प्रयोग सम्बन्धी अनुसन्धानहरु खासै भएको पाइदैन तथापि नेपालको बागबानी क्षेत्र खासगरी कट फ्लावर खेतीमा माटोको निर्मलिकरण कार्यमा नानो सिल्भर मिश्रित हाइड्रोजन पेरोक्साइडको प्रयोग ब्यापक रुपमा भइरहेको पाइन्छ । नेपालका केही प्रकाशनहरुमा नानो सिल्भर मिश्रित हाइड्रोजन पेरोक्साइडलाई पुष्प खेतीमा माटोको निर्मलिकरणको लागि सिफारिस गरिएको पाउन सकिन्छ । Shrestha and Adhikari (2024) ले कट फ्लावरको खेती गर्दा बिरुवा रोप्नु अघि नानो सिल्भर हाइड्रोजन पेरोक्साइडको घोलले माटो उपचार गर्न सिफारिस गरेका छन् । यसै गरी Pun and Shrestha (2021) ले सुनाखरी फूलखेती सम्बन्धी आफ्नो पुस्तिकामा नानो सिल्भर हाइड्रोजन पेरोक्साइड २ मि.लि. प्रति लिटर पानीमा मिसाएर छर्दा सिम्बिडियम सुनाखरीलाई फ्युजारियम र सर्कोस्पोरा लिफ स्पटबाट बचाउन सकिने कुरा उल्लेख गरेका छन् । Shrestha and Neupane-Paudel (2020) ले कारनेशन फूल खेती गर्दा बिरुवा रोप्नु अघि नानो सिल्भर हाइड्रोजन पेरोक्साइड ३५ मि.लि. प्रति लिटर पानीमा मिसाएर १ लिटर प्रति वर्ग मीटरको दरले प्रयोग गरी माटो निर्मलिकरण गर्न सल्लाह दिएका छन् ।

नानो सिल्भर वातावरण र मानव स्वास्थ्यको लागि कति सुरक्षित

नानो सिल्भरको एन्टिमाइक्रोबियल गुणका कारण स्वास्थ्य क्षेत्रमा, कृषि तथा पशुपालन एवं खानेपानी प्रशोधन आदि कार्यमा यसको ब्यापक प्रयोग भइरहेको छ । तर यो मानव स्वास्थ्य र वातावरणको लागि कति सुरक्षित छ

भन्ने प्रश्न पनि उठ्ने गरेको छ । जीवाणुको कोषभित्र छिरेर जीवकोषको भित्तालाई नै क्षति पुऱ्याउन सक्ने यसको क्षमताले बोट बिरुवा र मानिस र जनावरको कोषमा समेत क्षति पुऱ्याउन सक्ने सम्भावना माथि समेत विचार गर्नै पर्ने हुन्छ । जनावर तथा मानिसको कलेजोमा बाहिरबाट शरीरभित्र प्रवेश गर्ने विषालु पदार्थ जम्मा हुने भएकोले नानो सिल्भर पनि कलेजोको लागि हानिकारक हुन सक्दछ । यसको निरन्तर प्रयागबाट मानिसको मुटु, फोक्सो, रगतनली, स्नायु र प्रतिरक्षा प्रणाली समेत उत्तिकै जोखिममा पर्न सक्दछ (Rezvani et al., 2019) ।

कृषि क्षेत्रमा नानो सिल्भर प्रयोग गर्दा यो हावा, पानी र माटोमा सजिलै पुग्दछ र वातावरणमा नोक्सान पुऱ्याउन सक्दछ । लामो समयसम्म यसको प्रयोग गर्दा कतिपय जीवाणुले यसलाई पचाउने क्षमता विकास गर्न पनि सक्दछ । Graves et al. (2015) ले गरेको एक अध्ययन अनुसार Escherichia coli नामक ब्याक्टेरियामा लगातार नानो सिल्भर प्रयोग गर्दा २०० औं पुस्तामा पुगेपछि नानो सिल्भर पचाउने क्षमता विकास गर्दछ ।

हाइड्रोजन पेरोक्साइड जीवाणुनाशक क्षमताको लागि प्रभावकारी हुँदा हुदै पनि छिटै नै यो पानी र अक्सिजनमा परिणत हुने र यसले आफ्नो जीवाणु नाशक क्षमता गुमाउने हुनाले यसलाई थप प्रभावकारी बनाउन र यसको क्षमता लम्ब्याउन यसमा विभिन्न खालका नानो कणहरु मिसाएका हुन्छन् । नानो सिल्भर पनि त्यसैमध्ये एक हो । हाइड्रोजन पेरोक्साइडलाई मानव स्वास्थ्य र वातावरणको लागि पूर्णतः सुरक्षित मानिएता पनि यसमा मिसाइएको नानो सिल्भरको कारण यो कति सुरक्षित भन्ने प्रश्न उब्जिएको छ । तथापि नानो सिल्भर हाल प्रयोग भइरहेको रासायनिक विषादीहरु भन्दा निकै सुरक्षित छ भन्ने मान्यता राख्नेहरुको पनि कमि छैन । नेपालमा नानो सिल्भर हाइड्रोजन पेरोक्साइडको प्रयोग पुष्पको क्षेत्रमा मात्र सीमित रहेको देखिन्छ । खाद्यान्न, तरकारी र फलफूलको क्षेत्रमा यसको प्रयोग गर्नुपर्दा निकै सावधानीपूर्वक गर्नु पर्ने देखिन्छ । बिरुवाको शुरु अवस्थामा मात्र प्रयोग गर्ने, प्रयोग गर्दा खानेपानीको मुहानमा मिसिन नदिने आदि कुराहरुमा ध्यान दिन सके यसको राम्रो सदुपयोग गर्न सकिन्छ ।

निष्कर्ष तथा सारशं

नानो सिल्भर हाइड्रोजन पेरोक्साइडले बिरुवाहरुलाई रोगका जीवाणुबाट जोगाउन तथा बीउ गानो एवं कट फ्लावर डुबाउने घोललाई संक्रमणमुक्त बनाउन सहयोग गर्दछ । यसको प्रयोगबाट सिंचाईको पानी र पाइप, भण्डारगृह तथा औजार उपकरणहरुलाई समेत रोगमुक्त बनाउन सकिन्छ । नानो सिल्भरका कणहरुले इथिलिनको उत्सर्जनलाई समेत रोक्ने हुनाले यसले कट फ्लावरहरुको पोष्ट हार्भेष्ट अवधि बढाउन मदत गर्दछ । नानो सिल्भर हाइड्रोजन पेरोक्साइडको प्रयोग नेपालमा पुष्पको क्षेत्रमा भइरहेको छ तर यसको प्रयोग गर्ने तरीका, मात्रा र यसको प्रभावकारीताको बारेमा नेपालमा कुनै अनुसन्धान भएको छैन । यसको प्रयोग गर्ने मात्राको सम्बन्धमा समेत भएका लेख रचनाहरुमा एकरुपता भएको पाइदैन । त्यसैले नेपालको पुष्प क्षेत्रमा यसको प्रभावकारी उपयोग गर्न ठोस तथ्य र प्रमाणका आधारमा प्राविधिक सिफारिसका लागि यसको प्रयोगबाट विभिन्न बाली र जीवाणुहरुमा पर्ने प्रभाव, यसको प्रयोग गर्ने प्रभावकारी विधि र मात्रा सम्बन्धमा व्यवस्थित अनुसन्धान गर्नु अपरिहार्य भएको छ ।

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हिमालयन चेरी अर्थात पैयुँ फूल नेपालको पहिचान

कुवेर जङ मल्ल, (वनस्पति बिज्ञ)

बढ्दो सहरीकरण र गाडीहरुको धुवाँले गर्दा सहरमा प्रदुषणको मात्रामा बृद्धि हुँदै गइरहेको सर्वविदितै छ । प्रदुषणको मारलाइ न्यूनीकरण गर्न सहरलाइ स्वच्छ वातावरणको आबश्यकता पर्दछ । यसको लागि हरियाली प्रबर्द्धनको एकदमै आवश्यक छ । हरियालीयुक्त वातावरणको व्यवस्थापनले सहरका बासिन्दाहरुको शारीरिक तथा मानसिक स्वास्थ्यमा समेत सकारात्मक प्रभाव पार्दछ भने यसले सहरको सौन्दर्यतामा समेत योगदान पुर्‍याउँछ । स्वच्छ वातावरणको आवश्यकता पूर्ति गर्न हरियाली आजको युगको आबश्यकता हो । सहरका सडकको दायाँ बायाँ बृक्षारोपण गरी, अन्य खाली स्थानहरुमा बगैचा तथा पार्कहरुको निर्माण गरी हरियाली प्रबर्धन गर्न सकेमा प्रदुषणको मात्रा कम गर्नमा सहयोग पुर्‍याउँछ, त्यसैले भन्ने गरिन्छ - हरियाली सहरको जीवन हो ।

त्यसैले कुनै पनि सहरको लागि हरियाली अति आवश्यक छ । विश्वका सबै सहरहरुमा हरियालीको ब्यवस्थापन गर्ने गरिएको पाइन्छ । हाम्रो देशमा पनि विभिन्न सहरहरुका सडकका किनाराहरुमा रुख विरुवाहरु लगाएर हरियालीको मात्रामा बृद्धि गर्न आवश्यक देखिन्छ । त्यसका साथै सहरका खाली स्थानहरुमा पार्क तथा उद्यानहरुको निर्माण गरी विभिन्न शोभनीय विरुवाहरु लगाइ हरियालीको वातावरण तयार गर्नका साथै सहरको सौन्दर्यतामा समेत बृद्धि गर्ने गरीन्छ । हरियालीका साथै फुलेर ढकमक्क हुने रुख विरुवाहरुले सहरी सौन्दर्यतको लागि निकै महत्व राख्दछन् ।

नेपालका तराइ देखि पहाडी क्षेत्रका सहरहरुमा हरियाली तथा सौन्दर्यता बृद्धि गर्न अनेक किसिमका बोट विरुवाहरु लगाउने गरेको पाइन्छ । कुनै सदाबहार अर्थात सधै हरिया रहने बृक्षहरु हुन्छन भने कुनै पतझर खालका हुन्छन । पतझर बृक्षहरुको पनि आफ्नै विशेषता हुन्छ । यिनीहरुले शरद देखि शिशिर ऋतुको आगमनको संकेत दिने गर्दछन् । त्यस्तै गरी फूलफुल्ने बृक्षहरुको पनि आफ्नै महत्व छ । यी बृक्षका फूलहरुले सहरको सौन्दर्यतामा विशेष रंग भर्दछन् । तराइ तिर बसन्त ऋतुमा फूल्ने गुलमोहर, राजबृक्ष, पलाँस जस्ता रुखहरुले सहरको सौन्दर्यतामा बृद्धि गरेको पाइन्छ भने मध्य-पहाडी क्षेत्रका सहरहरुमा नीलो सिरिस (ज्याकारेण्डा), रुख कमल, क्यलियाण्ड्रा, आरु फूल, नीलकमल, कल्की, सुगा फूल आदि प्रजातिका बृक्षहरुले यहाँको सौन्दर्यतामा आयाम थप्ने गरेको पाइन्छ । वसन्तमा काठमाडौंका सडक किनाराहरु नीलो सिरिस (ज्याकारैण्डा) का फूलहरुले नीलाम्य पारी सिगारिएको देखिन्छ भने बर्षामा असारे जस्ता फूलहरुले सिगारिएको पाईन्छ ।

काठमाडौ लगायत नेपालका तराइ देखि पहाडसम्मका सहरहरुमा लगाइएका बृक्षहरु धेरैजसो विदेशबाट आयातित प्रजातिहरु छन । नेपालका सडकका दायाँ बायाँ वा उद्यान वा पार्कहरुमा विदेशी मूलका विरुवाहरुको नै बाहुल्यता देखिन्छ । खासगरी काठमाडौ सहरका सडक किनारा, बगैचा र पार्कहरुमा विदेशी मूलका विरुवाहरुको नै बाहुल्यता पाइन्छ । यहाँ पनि स्वदेशी बृक्षहरुले आफ्नो स्थान बनाउन सकेका छैनन । नेपाल जैविक विविधताले भरिपूर्ण देशको रुपमा चिनिन्छ । तर हामी हरियालीका साथै सहरी सौन्दर्यताको लागि आफ्ना स्वदेशी विरुवाहरुको प्रयोगमा पछि परेका छौं । यहाँ पनि सडक किनारा, बगैचा र पार्कहरुमा लगाएर सहरको सौन्दर्यता थप्ने विभिन्न रुख विरुवाहरु प्रशस्त छन । ती मध्ये एउटा पैंयु पनि हो ।

पैयुँको सौन्दर्यता

पैयुँलाइ अंग्रेजीमा Himalayan cherry भन्ने गरिन्छ । यसको बैज्ञानिक नाम Prunuscerasoides हो । चेरी प्रजातिका बनस्पतिहरु बानस्पतिक हिसाबले Prunus प्रजातिमा पर्दछन । त्यसो त नेपालमा Prunus का अन्य प्रजातिहरु पनि छन् । यी मध्ये नेपालको पूर्वी भाग ताप्लेजुंगमा पाइने Prunustaplejungnica, तोप्केगोलामा पाइने Prunustopkegolensis र पश्चिमको जाजरकोटमा पाइने Prunusjajarkotensis नेपालका रैथाने प्रजातिहरु हुन । यी मध्ये हिमालयन चेरीको नामले चिनिने पैयुँ चाहिं आकर्षक फूलफुल्ने प्रजातिमा पर्दछ । त्यस भन्दा पनि यो शरद ऋतुमा फुल्ने भएकोले यसको महत्व झन बढी छ, किनकि उक्त समयमा धेरै जसो विरुवाहरुको पात झर्ने समय हो । त्यस बेला फूलफुल्ने विरुवा अत्यन्तै कममात्र पाइन्छन । तर पैयुँ त्यतिखेर सेतो वा रातो रंगमा बोटै ढाक्ने गरी आकर्षित रुपमा फुल्ने गर्दछ र सबैलाइ आकर्षित गर्ने गर्दछ । यही नै पैयुँ फूलको विशिष्ठ पहिचान हो ।

यो नेपालको करीव १२०० देखि २४०० मीटर उचाइसम्मको मध्य पहाडी वन क्षेत्रमा पाइने ३० मीटरसम्म अग्लो हुने पतझर बृक्ष हो । पातझरेको बेला सेतो वा रातो रंगमा बोटै ढाक्ने गरी आकर्षित रुपमा फुल्ने गर्दछ र सबैलाई आकर्षित गर्ने गर्दछ ।



हिमालयन चेरीको नामबाट चिनिने पैयु फुलेको समय

यो विरुवाले हाम्रो संस्कृतिमा पनि प्राचीनकाल देखि नै धार्मिक तथा साँस्कृतिक महत्व राखेको पाइन्छ । विवाहको मण्डप होस वा गृह पूजामा यसका हाँगा वा पातहरुको आवश्यकता हुने गर्दछ । यसका केही औषधीय गुणहरु पनि छन् । यसको फल चराचरुङ्गीहरुका लागि आहार पनि भएकाले यसले चराचरुङ्गीहरुलाइ आकर्षित गर्ने गर्दछ । यो स्थान हेरी कार्तिक देखि मंसीरसम्म फुल्दछ ।

जापानको चेरी महोत्सव

पैयुँ अर्थात हिमालयन चेरीको कुरा गर्दा जापानी चेरीको पनि प्रसंग जोडन उचित नै होला । जापानमा फुल्ने जापानिज चेरीलाइ जापानी भाषामा साकुरा भन्ने गरिन्छ । यो पनि Prunus प्रजाति भित्र पर्दछ । जापानमा साकुरा बसन्तऋतुमा फुल्ने गर्दछ । त्यसैले जापानका विभिन्न सहरहरुमा प्रत्येक वर्ष बसन्त ऋतुमा चेरी ब्लसम फेस्टीभल (Cherry Blossomfestival) मनाउने गरीन्छ, जुन विश्वभरि नै प्रख्यात छ । त्यसलाई जापानी भाषामा साकुरा माचुरी भनिन्छ । जापानी भाषामा साकुरा भनेको चेरी र माचुरी भनेको उत्सब हो । यो महोत्सव जापानी संस्कृति, प्रकृति र जीवन दर्शनसंग गहिरो रुपमा जोडिएको छ । यो जापानको सबै भन्दा प्रसिद्ध साँस्कृतिक पर्व मध्ये एक हो ।



जापानमा चेरी फेस्टीभलका दृश्यहरु

नेपालमा हिमालयन चेरी फेष्टिभलको (Himalayan cherry festival) संभावना

त्यसै गरी नेपालमा प्राकृतिक रुपमा फुल्ने पैयुँलाइ स्थानीय सरकार, पर्यटन बोर्ड, स्थानीय समुदाय र सरोकारवालाहरु बीच सहकार्य गरेर सहरका सडक किनाराहरु, बगैचाहरु र पार्कका साथै अन्य स्थानहरुमा व्यवस्थित र यनोजनाबद्ध रुपमा लगाएर पैयुँ जस्तो महत्वपूर्ण स्वदेशी विरुवाको प्रयोगलाई प्रोत्साहन गर्न सकेमा नेपालमा पनि पैयुँ महोत्सव Himalayan cherry festival मनाउने जस्ता कार्यक्रमहरु विकास गर्न सकिने सम्भावना देखिन्छ । यसले नेपालको आन्तरिक पर्यटन प्रबर्धन गर्न सहयोग पुर्‍याउनका साथै नेपालको स्वदेशी बनस्पतिको पहिचान तथा प्रयोगमा समेत टेवा पुग्ने सम्भावना रहन्छ, किनकि पैयुँ नेपालको प्राकृतिकका साथै सास्कृतिक सम्पदा पनि हो । त्यसो त शरद ऋतु नेपालमा पर्यटन भित्रिने प्रमुख समय हो, त्यस कारण यो विदेशी पर्यटक बीच पनि नेपाल चिनाउने एक उत्तम कार्यक्रम बन्न सक्छ र पर्यटकहरुलाई बढी उत्साहित गर्न सक्दछ । त्यति मात्र होइन यो जाडो मौसममा फुल्ने हिमाली सौन्दर्यताको रुपमा परिचित हुनका साथै पैयुँ फूल अर्थात हिमालयन चेरी नेपालको पहिचान बन्न सक्छ ।

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शोरूम: कम्फर्ट हाउजिङ्ग गेट, एलो गुम्बा, सानो भन्याङ्ग
फार्म: टेम्पो पार्क, रामकोट | शाखा: नाम्गेल चोक, ठुलो भन्याङ्ग



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- गार्डेन डिजाइन र ल्याण्डस्केप
- सिजनल फूल, वेना फलफुल तथा इन्डोर विरूवाहरू
- दूवो रोप्ने र छाप्नको लागि
- मेशिनबाट दूवो काट्न परेमा
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राजकृष्ण बजगाँई
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हाम्रो सेवाहरू:

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नेपालको फ्लोरिकल्चर उद्योग: सम्भावना, चुनौती र रणनीतिक भविष्य

(दिलिप बादे, जय किसान नर्सरी)

१. भूमिका : फ्लोरिकल्चर - विलासिताबाट आवश्यकतासम्म

नेपालमा फ्लोरिकल्चर (फूल तथा सजावटी बिरुवा व्यवसाय) लाई विगतमा प्रायः "सजावटको क्षेत्र" वा "विलासितासँग सम्बन्धित व्यवसाय" को रूपमा हेर्ने गरिन्थ्यो । तर वर्तमान परिवेशमा यस उद्योगको स्वरूप र महत्व दुवै उल्लेखनीय रूपमा परिवर्तन भएका छन्। आज फ्लोरिकल्चर केवल फूल बेच्ने वा बगैंचा सजाउने कार्य मात्र होइन; यो एक बहुआयामिक एग्रो-बिजनेस उद्योग हो जसले रोजगारी सिर्जना, शहरी सौन्दर्य अभिवृद्धि, पर्यटन प्रवर्द्धन, सांस्कृतिक परम्पराको संरक्षण तथा उद्यमशीलता विकासमा महत्वपूर्ण योगदान पुऱ्याइरहेको छ । शहरीकरणको तीव्र विस्तार, जीवनशैलीमा आएको परिवर्तन, विवाह, उत्सव, कार्यक्रम तथा होटल-रिसोर्ट उद्योगको विकाससँगै फूल तथा सजावटी बिरुवाको माग निरन्तर बढिरहेको छ । यसले फ्लोरिकल्चरलाई आर्थिक दृष्टिले सम्भावनायुक्त क्षेत्रका रूपमा स्थापित गरेको छ । आजको आवश्यकता भनेको यस क्षेत्रलाई केवल सौन्दर्यसँग मात्र जोडेर नहेरी, राष्ट्रिय अर्थतन्त्रसँग जोडिएको एक सशक्त कृषि-उद्योगका रूपमा पहिचान र प्रवर्द्धन गर्नु हो । नेपालको भौगोलिक विविधता, सांस्कृतिक समृद्धि र उद्यमशील युवा जनशक्तिको उपस्थितिले फ्लोरिकल्चर उद्योगलाई आगामी दशकमा देशको एक प्रमुख व्यावसायिक क्षेत्रका रूपमा विकास गर्ने पर्याप्त आधार तयार गरिसकेको छ । अब आवश्यक छ—दीर्घकालीन दृष्टिकोण, नीति-सुधार, प्रविधिको समुचित उपयोग र बजार-केन्द्रित उत्पादन प्रणालीको विकास ।

२. नेपालको फ्लोरिकल्चर उद्योगको वर्तमान अवस्था

नेपालमा व्यावसायिक फ्लोरिकल्चरको सुरुवात केही दशक अघि सिमित स्तरमा भए पनि आज यसले व्यवस्थित उद्योगको स्वरूप ग्रहण गर्न थालेको छ । काठमाडौँ उपत्यका, चितवन, काभ्रे, झापा, पोखरा तथा अन्य उपयुक्त जलवायु भएका क्षेत्रहरूमा कट-फ्लावर, गमला बिरुवा, नर्सरी उत्पादन तथा ल्यान्डस्केपिङ व्यवसाय विस्तार हुँदै गएको छ । हाल घरेलु बजार नै फ्लोरिकल्चर व्यवसायको मुख्य आधार बनेको छ । विवाह, जन्मदिन, धार्मिक कार्यक्रम, सरकारी तथा निजी समारोह, होटल-रिसोर्ट सजावट र कार्यालय सजावटका लागि फूल तथा बोट बिरुवाको प्रयोग बढ्दै गएको छ । यसले दैनिक मागको दायरा विस्तार गरेको छ। तथापि, धेरैजसो उच्च गुणस्तरका फूल तथा विशेष प्रजातिका बिरुवाहरू अझै पनि आयातमा निर्भर रहनुपरेको यथार्थ छ, जसले घरेलु उत्पादनको प्रतिस्पर्धात्मक क्षमता बढाउनुपर्ने आवश्यकता स्पष्ट देखाउँछ ।

नर्सरी व्यवसाय, ल्यान्डस्केपिङ सेवा, इनडोर प्लान्ट र सजावटी बिरुवाको बजार विस्तार हुनु सकारात्मक संकेत हो। डिजिटल माध्यम र सामाजिक सञ्जालको प्रयोगले फूल तथा बिरुवा बिक्रीको नयाँ प्लेटफर्म तयार भएको छ । यसले साना उद्यमी देखि ठूला व्यवसायीसम्मलाई बजार पहुँच विस्तार गर्ने अवसर प्रदान गरेको छ ।

३. सम्भावनाहरू : नेपालका लागि फ्लोरिकल्चर किन भविष्यको उद्योग हो ?

३.१ भौगोलिक र हावापानी विविधता

नेपालको तराईदेखि हिमाली क्षेत्रसम्म फैलिएको जलवायु विविधताले विभिन्न प्रजातिका फूल तथा सजावटी बिरुवा उत्पादनका लागि अनुकूल वातावरण प्रदान गर्दछ । उष्णकटिबन्धीय देखि समशीतोष्ण जलवायुसम्मको उपलब्धताले देशलाई प्राकृतिक रूपमा बहुप्रजातीय उत्पादनको क्षमता प्रदान गरेको छ ।

३.२ युवा तथा महिला उद्यमशीलता

फ्लोरिकल्चर क्षेत्रले कम जमिन, तुलनात्मक रूपमा कम लगानी र उच्च मूल्य प्राप्त हुने सम्भावना भएकोले युवा तथा महिला उद्यमीहरूका लागि आकर्षक व्यवसायका रूपमा उभिएको छ । स्वरोजगार सिर्जना र साना-मझौला उद्यम विकासका लागि यो क्षेत्र प्रभावकारी माध्यम बन्न सक्छ ।

३.३ शहरी मागको निरन्तर वृद्धि

शहरीकरण, जीवनशैली परिवर्तन, हरियालीप्रतिको रुचि तथा इनडोर-आउटडोर सजावटको बढ्दो संस्कृतिले फूल तथा बिरुवाको स्थायी माग सिर्जना गरेको छ । घर, कार्यालय, होटल, रिसोर्ट, अस्पताल तथा शैक्षिक संस्थाहरूमा हरियाली सजावटको प्रयोग बढ्दै गएको छ ।

३.४ निर्यात सम्भावना

गुणस्तरीय उत्पादन, उचित भण्डारण तथा ढुवानी व्यवस्थापन गर्न सकेमा छिमेकी देशहरू तथा अन्तर्राष्ट्रिय बजारमा पनि नेपाली फूल तथा सजावटी बिरुवाको निर्यात सम्भावना प्रशस्त रहेको छ । विशेष गरी अर्गानिक तथा हिमाली प्रजातिका फूलहरू विशिष्ट बजारका लागि आकर्षक हुन सक्छन् ।

३.५ पर्यटन र कार्यक्रम उद्योगसँग सम्बन्ध

पर्यटन, विवाह उद्योग, कार्यक्रम व्यवस्थापन तथा आतिथ्य व्यवसायसँग फ्लोरिकल्चरको प्रत्यक्ष सम्बन्ध छ । यस क्षेत्रको विकासले पर्यटनको गुणस्तर वृद्धि तथा समग्र सेवा उद्योगको स्तर उकास्न मद्दत गर्दछ ।

४. चुनौतीहरू : यथार्थ स्वीकारेर समाधानतर्फ

सम्भावना प्रशस्त हुँदाहुँदै पनि फ्लोरिकल्चर उद्योगले विभिन्न संरचनागत तथा व्यवहारिक चुनौतीहरूको सामना गरिरहेको छ ।

४.१ उच्च उत्पादन लागत

बीउ, रोपाइँ सामग्री, मलखाद, संरचना निर्माण तथा श्रम लागत अपेक्षाकृत महँगो भएकाले उत्पादन लागत उच्च हुने गरेको छ। यसले प्रतिस्पर्धात्मक मूल्यमा उत्पादन उपलब्ध गराउन कठिनाइ उत्पन्न गर्छ ।

४.२ गुणस्तर र मानकीकरणको अभाव

अन्तर्राष्ट्रिय स्तरको गुणस्तर, ग्रेडिङ, प्याकेजिङ तथा भण्डारण प्रणालीको अभावले निर्यात तथा उच्चस्तरीय बजारमा प्रतिस्पर्धा गर्न चुनौती पैदा गरेको छ ।

४.३ बजार अस्थिरता

मौसमी माग, कार्यक्रम-केन्द्रित खपत र मूल्यमा उतार-चढावका कारण किसान तथा व्यवसायीले स्थिर आम्दानी सुनिश्चित गर्न सकिरहेका छैनन् ।

४.४ प्राविधिक दक्षता र तालिमको कमी

उन्नत प्रविधि, रोग-कीरा व्यवस्थापन, आधुनिक ग्रीनहाउस सञ्चालन तथा बजार-केन्द्रित उत्पादनबारे पर्याप्त तालिम र परामर्श सेवाको अभाव छ ।

४.५ नीति तथा संस्थागत प्राथमिकताको कमी

फ्लोरिकल्चरलाई अझै पनि कृषि क्षेत्रभित्रको एक सानो उप-क्षेत्रको रूपमा मात्र हेरिएको पाइन्छ । यसले दीर्घकालीन नीति, अनुसन्धान तथा प्रोत्साहन कार्यक्रमहरूमा अपेक्षित प्राथमिकता पाउन नसकेको अवस्था छ ।

४.६ अनुसन्धान र विस्तार सेवाबीचको दूरी

अनुसन्धानबाट प्राप्त ज्ञान र किसानसम्म पुग्ने व्यवहारिक जानकारीबीच तालमेल अभाव हुँदा उत्पादन क्षमता पूर्ण रूपमा उपयोग हुन सकेको छैन ।

५. नीति तथा संस्थागत सुधार : अबको अनिवार्य आवश्यकता

फ्लोरिकल्चर उद्योगलाई दिगो र प्रतिस्पर्धात्मक बनाउन स्पष्ट राष्ट्रिय दृष्टिकोण र नीतिगत सुधार अत्यावश्यक छन् । सबैभन्दा पहिले, राष्ट्रिय स्तरमा स्पष्ट Floriculture Development Policy आवश्यक छ, जसले उत्पादन, बजार, अनुसन्धान, निर्यात तथा गुणस्तर मापदण्डलाई समेट्ने दीर्घकालीन मार्गचित्र प्रदान गर्न सकोस् । सहुलियत तथा अनुदान कार्यक्रमहरू केवल वितरणमुखी नभई उत्पादन क्षमता, गुणस्तर सुधार र बजार विस्तारसँग प्रत्यक्ष

जोडिनुपर्छ । निर्यात प्रवर्द्धनका लागि क्वारेन्टाइन, प्रमाणिकरण, भण्डारण तथा ढुवानी पूर्वाधारको विकास अनिवार्य छ । नर्सरी प्रमाणिकरण प्रणाली, गुणस्तर नियन्त्रण प्रयोगशाला, अनुसन्धान केन्द्र र तालिम कार्यक्रमलाई सुदृढ बनाउनु आजको आवश्यकता हो । सार्वजनिक-निजी साझेदारी (PPP) को माध्यमबाट प्रविधि, लगानी र बजार व्यवस्थापनमा सहकार्य बढाउन सके उद्योगको समग्र संरचना सुदृढ हुन सक्छ ।

६. बजार-केन्द्रित उत्पादन : किसानदेखि व्यवसायीसम्मको रूपान्तरण

फ्लोरिकल्चर व्यवसायको दिगोपनाको आधार भनेको बजार-केन्द्रित उत्पादन प्रणाली हो । मागको अध्ययन बिना केवल उत्पादनमा केन्द्रित हुने प्रवृत्तिले बजार असन्तुलन सिर्जना गर्दछ । त्यसैले बजार विश्लेषण, माग-आपूर्ति व्यवस्थापन र दीर्घकालीन व्यावसायिक योजना अनिवार्य छन् ।

कन्ट्र्याक्ट फार्मिङ, क्लस्टर आधारित उत्पादन, मूल्य अभिवृद्धि (Value Addition), ब्रान्डिङ र आकर्षक प्याकेजिङले उत्पादनको प्रतिस्पर्धात्मकता बढाउन सक्छ । डिजिटल मार्केटिङ, अनलाइन अर्डर प्रणाली र होम-डेलिभरी सेवा जस्ता आधुनिक व्यापारिक अभ्यासले नयाँ बजार विस्तार गर्न महत्वपूर्ण भूमिका खेल्न सक्छ । किसानलाई केवल उत्पादक नभई उद्यमीको रूपमा विकास गर्न आवश्यक छ, जसले उत्पादनसँगै बजार, लागत व्यवस्थापन र ग्राहकको आवश्यकता बुझेर निर्णय गर्न सकून् ।

७. स्मार्ट फ्लोरिकल्चर र प्रविधिको प्रयोग

आधुनिक युगमा प्रविधिको प्रयोग बिना फ्लोरिकल्चर उद्योगको तीव्र विकास सम्भव छैन । ग्रीनहाउस, पोलीहाउस, ड्रिप इरिगेशन, क्लाइमेट-कन्ट्रोल सिस्टम जस्ता प्रविधिले उत्पादनको गुणस्तर र स्थिरता दुवै बढाउन सक्छ ।

डिजिटल प्लेटफर्म, मोबाइल एप्स, अनलाइन मार्केटिङ तथा डेटा-आधारित निर्णय प्रणालीले उत्पादन योजना र बजार पहुँच सुधार गर्न सहयोग पुऱ्याउँछन् । जलवायु परिवर्तनका चुनौतीहरूलाई ध्यानमा राखी स्मार्ट र जलवायु-अनुकूल खेती प्रणाली विकास गर्नु पनि अत्यन्त आवश्यक छ ।

८. आगामी १० वर्षको रणनीतिक मार्गचित्र (२०२६-२०३६)

अल्पकालीन (१-३ वर्ष)

- गुणस्तर नर्सरी विकास
- किसान तथा उद्यमी तालिम कार्यक्रम
- बजार सूचना प्रणाली स्थापना

मध्यमकालीन (४-६ वर्ष)

- क्लस्टर आधारित उत्पादन क्षेत्र विकास
- भण्डारण, ढुवानी र प्याकेजिङ पूर्वाधार सुधार
- राष्ट्रिय ब्रान्डिङ अभियान सञ्चालन

दीर्घकालीन (७-१० वर्ष)

- निर्यातमुखी उत्पादन प्रणाली स्थापना
- अनुसन्धान तथा प्रविधि केन्द्र विस्तार
- अन्तर्राष्ट्रिय बजारमा "Nepal Floriculture" को पहिचान निर्माण

९. निष्कर्ष : फ्लोरिकल्चर - व्यवसाय, सौन्दर्य र आर्थिक समृद्धिको संगम

नेपालको फ्लोरिकल्चर उद्योग सम्भावनाले भरिपूर्ण तर रणनीतिक योजना अभावले पूर्ण रूपमा उपयोग हुन नसकेको क्षेत्र हो । यदि नीति सुधार, प्रविधि प्रयोग, बजार-केन्द्रित उत्पादन र संस्थागत सहकार्यलाई समन्वित रूपमा अघि बढाउन सकियो भने आगामी दशकमा यो उद्योगले राष्ट्रिय अर्थतन्त्रमा महत्वपूर्ण योगदान पुऱ्याउन सक्छ । यस क्षेत्रको दिगो विकासका लागि सरकार, निजी क्षेत्र, अनुसन्धान संस्था, व्यावसायिक संघसंस्था तथा किसान सबैको साझा सहकार्य आवश्यक छ । फ्लोरिकल्चरलाई केवल सौन्दर्यको माध्यम नभई आर्थिक समृद्धि, हरित वातावरण र उद्यमशीलताको आधारका रूपमा स्थापित गर्नु आजको आवश्यकता हो ।

आशावादी दृष्टिकोण, व्यवहारिक रणनीति र दीर्घकालीन प्रतिबद्धताका साथ अघि बढेमा नेपालको फ्लोरिकल्चर उद्योगले निकट भविष्यमा राष्ट्रिय तथा अन्तर्राष्ट्रिय स्तरमा सम्मानित स्थान हासिल गर्ने विश्वास गर्न सकिन्छ ।

सन्दर्भ सामग्रीहरू

१. फ्लोरिकल्चर एसोसिएसन नेपाल (FAN). विभिन्न वर्ष प्रकाशित Floriculture Souvenir (विभिन्न अंकहरू), काठमाडौं ।

२. फ्लोरिकल्चर एसोसिएसन नेपाल (FAN). नेपालको पुष्प व्यवसाय सम्बन्धी वार्षिक प्रतिवेदनहरू (विभिन्न वर्ष) ।

३. कृषि तथा पशुपन्छी विकास मन्त्रालय. कृषि विकास रणनीति (Agriculture Development Strategy – ADS २०१५-२०३५)।

४. कृषि तथा पशुपन्छी विकास मन्त्रालय. कृषि तथ्यांक तथा वार्षिक प्रगति प्रतिवेदन (विभिन्न वर्ष) ।

५. राष्ट्रिय तथ्यांक कार्यालय (पूर्व केन्द्रीय तथ्यांक विभाग). नेपालको जनगणना तथा आर्थिक तथ्यांक ।

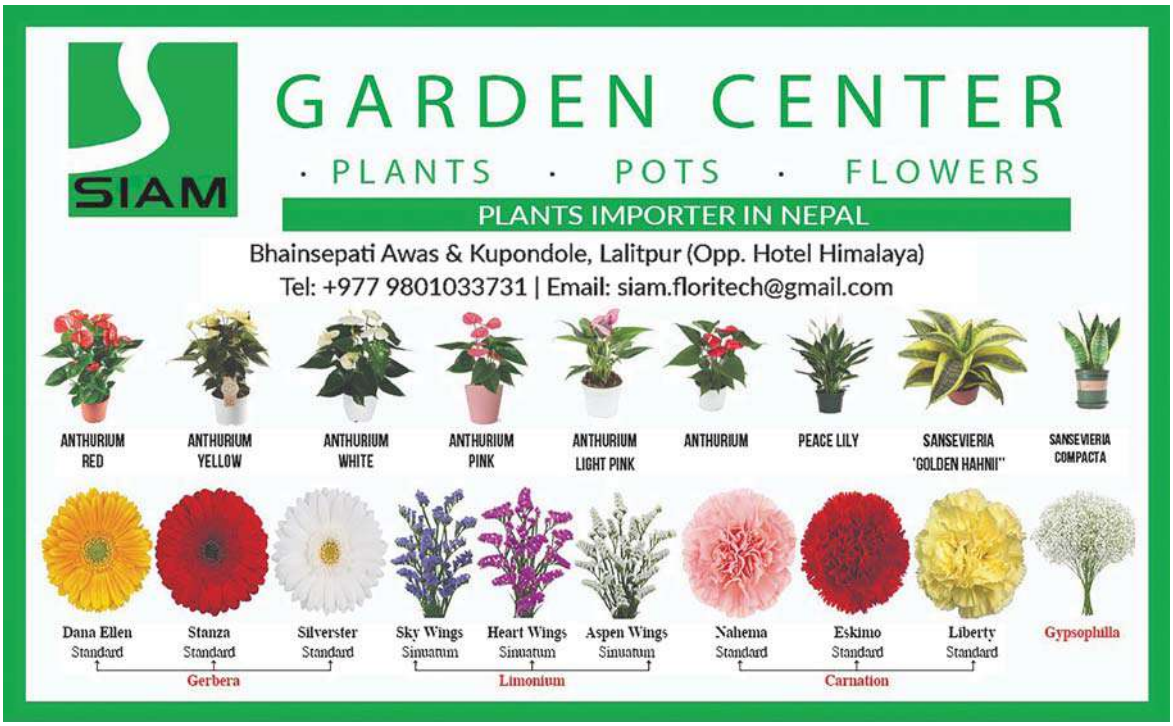
६. Food and Agriculture Organization (FAO) को विभिन्न प्रकाशनहरू तथा फ्लोरिकल्चर सम्बन्धी Technical Papers ।

७. International Association of Horticultural Producers, International Statistics Flowers and Plants (विभिन्न वर्ष)।

८. Royal Horticultural Society (RHS), Horticulture & Ornamental Plants सम्बन्धी प्रकाशनहरू ।

९. International Society for Horticultural Science, विभिन्न वैज्ञानिक लेख तथा Proceedings।

१०. विभिन्न राष्ट्रिय दैनिक, कृषि पत्रपत्रिका तथा फ्लोरिकल्चर सम्बन्धी प्रकाशित अनुसन्धानात्मक लेखहरू ।



साइटिस र सुनाखरी

दिपक लामिछाने
वरिष्ठ वैज्ञानिक अधिकृत वनस्पति विभाग

पृष्ठभूमी

दुर्लभ वन्यजन्तु तथा वनस्पतिका प्रजातिहरुको विश्वव्यापी संरक्षण प्रयासलाई व्यवस्थित गर्न दुर्लभ वन्यजन्तु र वनस्पतिको अन्तर्राष्ट्रिय व्यापार महासन्धी (Convention on International Trade in Endangered Species of Wild Flora and Fauna) को जन्म भएको थियो । यसलाई छोटकरीमा साइटिस (CITES) भनिन्छ । यो महासन्धी सन् १९७५ देखि कार्यान्वयनमा आएको छ । नेपाल पनि यो महासन्धीको पक्ष राष्ट्र हो र यो महासन्धि कार्यान्वयन गर्नको लागि साइटिस ऐनको व्यवस्था गरी कार्यान्वयनमा रहेको छ ।

साइटिस महासन्धीले विभिन्न वन्यजन्तु र वनस्पतिलाई ३ वटा अनुसूचिमा समावेश गरी संरक्षण र दिगो उपयोगको व्यवस्था गरेको छ । अनुसूची र तिनीहरुमा भएका व्यवस्थाहरु यस प्रकार रहेका छन् ।

अनुसूची १

साइटिस महासन्धीको अनुसूची १ मा लोप हुने स्थितिमा पुगेका दुर्लभ वनस्पति प्रजातिहरु समावेश गरिएको छ । पूर्णरुपमा संरक्षण गर्नु पर्ने भएकोले त्यस्ता प्रजातिहरुको व्यापारमा पूर्णतया रोक लगाईएको छ । अध्ययन अनुसन्धान शैक्षिक प्रदर्शनीका लागि मात्र यी प्रजातिहरुको ओसार पसार गर्न पाईन्छ । यस अनुसूचीमा नेपालमा पाईने सुनाखरी प्रजाति Paphiopedilum रहेको छ ।

अनुसूची २

दुर्लभ हुदै गएका प्रजाती जस्को व्यापारलाई समयमै नियन्त्रण नगर्ने हो भने निकट भविष्यमै लोप हुन सक्ने स्थितिमा रहेका प्रजातिलाई अनुसूची २ मा समावेश गरिएको छ । यस अनुसूचीमा समावेश भएका प्रजातिहरुको अन्तर्राष्ट्रिय व्यापारको नियन्त्रण सम्वन्धी व्यवस्था साईटिस महासन्धीमा भएको छ । ४५० प्रजातिका सुनाखरी सहित अन्य प्रजातिका वनस्पतिहरु यो अनुसूचीमा रहेका छन् ।

अनुसूची ३

कुनै देशले आफ्ना राष्ट्रका कुनै प्रजातिको व्यापार र ओसारपसारमा नियन्त्रण गर्नु पर्ने आवश्यक्ता महशुस भएका प्रजातिहरुलाई अनुसूची ३ मा समावेश गरिन्छ । त्यस्ता प्रजातिहरुको ओसार पसारका लागि सम्वन्धित सरोकारवाला निकायबाट ईजाजत लिन आवश्यक हुन्छ । तसर्थ अनुसूची १ मा दुर्लभ प्रजाति अनुसूची २ मा लोपोन्मुख र अनुसूची ३ मा संरक्षित वनस्पति राखिएको छ । साथै सङ्कटापन्न वनस्पति भन्नाले समग्रमा दुर्लभ लोपोन्मुख र संरक्षित वनस्पति भन्ने वुझ्नु पर्दछ ।

सुनाखरी

संसारभर करीव ३०,००० प्रजातिका सुनाखरी पाईन्छन् भने नेपालमा हालसम्म प्राकृतिक रुपमा ४५१ प्रजातिका सुनगाभा वा सुनाखरी (Orchids) पाईन्छ । रङ्ग र आकारका साथै आकर्षक फूल फुल्ने नेपाली शोभनीय तथा आलाङ्कारिक महत्वका सुनाखरीहरु वगैंचा तथा घरको शोभा वढाउन पुष्प गुच्छा र भित्री सजावटका लागि पनि उपयुक्त हुन्छन् । फ्लोरिकल्चर एशोसियसन नेपालले प्रकाशन गरेका व्यवसायिक सम्भावना भएका फूल फुल्ने नेपाली शोभनीय वनस्पतिमा विभिन्न प्रजातिका सुनाखरीलाई पनि समेटेको छ । उदाहरणका लागि घोगे गाभा (Rhyncostylis retusa), चाँदिगाभा (Coelogyne cristata), सुनगाभा (Dendrobium densiflorum), मालिनी फूल (Dendrobiumaphyllum), हात्ती टाउके (Pleione humilis) रहेका छन् ।



सुनखरी (*Dendrobium fimbriatum*)



सुनगाभा (*Dendrobium densiflorum*)



पाँच औले (*Dactylorhizahetagirea*)



मालिनी फस्ल (*Dendrobium aphyllum*)

नेपालमा प्राकृतिक रुपमा पाइने सुनाखरीहरू आलाङ्कारिक फूलको अलावा जैविक विविधता र पारिस्थितिकीय प्रणालिमा सन्तुलन गर्न, औषधीय वनाउन, पर्यापर्यटनका साथै र सामाजिक-आर्थिक तथा साँस्कृतिक दृष्टिले महत्वपूर्ण छन् । उदाहरणको रुपमा सिराहाको सहलेस फूलवारीमा हरामको रुखमा सहलेश प्रजातिको सुनाखरी (Dendrobium aphyllum) फुल्दा विशेष गरी प्रत्येक वर्ष वैशाख १ गते उक्त फुलेको सुनाखरी हेर्न हजारौं मानिसहरुको मेला लाग्ने गर्दछ । हुनत उक्त फूल १ गते मात्रै फूल्ने भनेर प्रचार गरिएता पनि यसको फूल फूल्ने समय भनेको चैत देखि जेष्ठ महिनासम्म रहेको पाईन्छ । यो सुनाखरीलाई मालिनी फूलको नामले समेत चिनिन्छ ।

नेपालमा सुनाखरी सम्बन्धी कानुनी तथा संस्थागत व्यवस्था

पाँच औंले जातको सुनाखरी (Dactylorhizahetagirea) संरक्षणका लागि मुख्य कानुन वन ऐन, २०७६ हो । यस ऐनका अनुसार पाँच औंलेलाई सङ्कलन उपयोग विक्री वितरण ओसार पसार र विदेश निकासीका लागि प्रतिवन्ध लगाईएको छ । साथै यो प्रजाति साइटिसको अनुसूची २ मा सुचीकृत छ ।

नेपालले साइटिस ऐन, २०७३ तथा साइटिस नियमावली, २०७६ मार्फत साइटिस कार्यान्वयनका लागि व्यवस्थित कानुनी तथा संस्थागत संरचनाको व्यवस्था गरेको छ। यी ऐन तथा नियमावलीले वैज्ञानिक तथा व्यवस्थापन निकायको काम, कर्तव्य तथा जिम्मेवारी तोकिएको छ । साथै व्यावसायिक नर्सरीहरूको जिम्मेवारीको वारेमा समेत उल्लेख गरिएको छ ।

साइटिस वनस्पतिका लागि संस्थागत व्यवस्था

साइटिस सम्वन्धी कानुन कार्यान्वयन प्रयोजनका लागि साइटिस ऐनमा नै व्यवस्थापन र वैज्ञानिक निकायको व्यवस्था गरिएको छ ।

व्यवस्थापन निकाय:

साइटिसको वनस्पति सम्वन्धी व्यवस्थापन निकायका रूपमा वन तथा भू-संरक्षण विभाग रहेको छ ।

व्यवस्थापन निकायको प्रमुख काम, कर्तव्य तथा अधिकार:

क) संकटापन्न वन्यजन्तु वा वनस्पति वा तिनका नमुनाको निर्यात वा आयात यस ऐन वा यस अन्तर्गत बनेका नियम अनुसार भइरहेको छ वा छैन भन्ने नियमित अनुगमन गर्ने ।

ख) कुनै इजाजतपत्र प्राप्त व्यक्ति, संस्था वा निकायले यस ऐन, नियम वा इजाजतपत्रमा उल्लिखित सर्त उल्लुन गरेमा इजाजतपत्र खारेज गर्ने ।

ग) संकटापन्न वन्यजन्तु वा वनस्पति सम्बन्धी अध्ययन तथा अनुसन्धान सञ्चालन गर्ने र त्यस सम्बन्धी प्रचार प्रसार गर्ने ।

घ) महासन्धि कार्यान्वयनको अवस्था सम्बन्धी नीतिगत, संस्थागत तथा कानुनी उपायहरूबारे आवधिक प्रतिवेदन तयार गर्ने ।

ङ) तोकिए बमोजिमका अन्य कार्य गर्ने ।

वैज्ञानिक निकाय:

साइटिसको वनस्पति सम्वन्धी वैज्ञानिक निकायका रूपमा वनस्पति विभाग रहेको छ ।

वैज्ञानिक निकायकोप्रमुख काम, कर्तव्य तथा अधिकार:

क) नेपालमा उपलब्ध संकटापन्न वनस्पतिको अवस्था तथा अस्तित्वबारे नियमित अध्ययन तथा अनुसन्धान गरी व्यवस्थापन निकायलाई आवश्यक परामर्श दिने र आवश्यक प्रतिवेदन प्रकाशन गर्ने ।

ख) संकटापन्न वन्यजन्तु वा वनस्पतिको स्वस्थताको प्रमाणपत्र जारी गर्ने ।

ग) आवश्यकता अनुसार संकटापन्न वन्यजन्तु वा वनस्पति सम्बन्धी परामर्श तथा राय व्यवस्थापन निकायलाई उपलब्ध गराउने ।

घ) संकटापन्न वन्यजन्तु वा वनस्पतिको परिचय, पहिचान तथा वर्गीकरण सम्बन्धी निर्णय गर्ने ।

ङ) संकटापन्न वन्यजन्तु वा वनस्पतिका वैज्ञानिक तथा प्राविधिक पक्षसम्बन्धी प्रचार प्रसार गर्ने वा गराउने ।

च) संकटापन्न वन्यजन्तु तथा वनस्पति संरक्षणसँग सम्बन्धित भएका विभिन्न निकायबीच समन्वय कायम गर्ने ।

छ) तोकिए बमोजिमका अन्य कार्य गर्ने ।

प्रमुख कानुनी प्रावधानहरू

साइटिस ऐन लागू हुनुअघि वा पछि राखिएका संकटापन्न प्रजातिहरूको दर्ता अनिवार्य गरिएको छ । साथै निम्न कार्यका लागि अनुमति आवश्यक पर्ने र अनुमति पत्र लिन चाहने व्यक्ति, संस्था वा निकायले नियामावालीमा उल्लेख भएको ढाँचामा व्यवस्थापन निकाय समक्ष निवेदन दिनु पर्दछ ।

- साइटिसमा सुचिकृत वनस्पति वा नमुनाको निर्यात, आयात तथा पुनःनिर्यातका लागि
- रोप्न हुर्काउन वा सोको नमुना राख्न प्रयोग गर्न उत्पादन गर्न वा ओसार पसार गर्न
- खेती, प्रवर्धन तथा स्वामित्वमा राख्ने कार्यका लागि
- खरिद विक्री, अध्ययन अनुसन्धान, परीक्षण, तालिम, प्रदर्शनी, संरक्षण शिक्षार शैक्षिक प्रयोजनका लागि
- वीउको रुपमा व्यापार गर्न ।

नर्सरी सम्बन्धी व्यवस्था

साइटिस अन्तर्गत सुचीकृत वनस्पतिको खेती र व्यापार व्यवसाय गर्न चाहने नर्सरीहरूले

- माउ बिरुवाको स्रोत खुलाउनुपर्ने
- प्रशासणको विधि उपलब्ध गराउनुपर्ने
- व्यावसायिक निर्यातका लागि उत्पादनको अनुमान प्रस्तुत गर्नुपर्ने र
- व्यवस्थापन निकायबाट स्वीकृति लिनुपर्ने जस्ता प्रावधानहरु राखिएको छ ।

अनुसूची १ का प्रजातिका लागि विशेष व्यवस्था लागू हुन्छ, जस अनुसार दर्ता भएका नर्सरीबाट कृत्रिम रूपमा प्रशारण र उत्पादन गरिएका बिरुवामात्र अन्तर्राष्ट्रिय व्यापार गर्न सकिन्छ ।

संरक्षण तथा व्यावसायिक प्रभाव

विश्वव्यापी रूपमा वन्यजन्तु तथा वनस्पतिको अस्थिर व्यापारलाई जैविक विविधता ह्रासको प्रमुख कारकका रूपमा मानिएको छ । सुनाखरीको व्यापारको अनुगमन तथा नियमन सजिलो कार्य होइन, र केही व्यापार ई-कमर्स बजारमा वनजन्य सुनाखरीको अनलाइन बजारतर्फ सरेका कारण नयाँ चुनौतीहरू देखिएका छन् ।

कानुनी रूपमा व्यापार हुने सुनाखरीका प्रजातिहरू वनबाट सङ्कलित भए पनि तिनको कानुनी व्यावसायिक व्यापारलाई भने अनुमति दिन्छ, तर यस्तो व्यापारका लागि आयात तथा निर्यात अनुमति आवश्यक हुन्छ र निर्यातले प्रजातिको अस्तित्वमा नकारात्मक असर नपार्ने कुरा साइटिसको अहानिकारक निष्कर्षहरु (Non–Detriment Finding-NDF) मार्फत आवश्यक पर्दछ । तर पनि साइटिस अनुसूची १ मा सूचीकृत Paphiopedilum प्रजातिहरु कानुनी रूपमा प्राप्त माउस्रोतबाट कृत्रिम रूपमा प्रशासण र उत्पादन गरिएको बाहेक अन्तर्राष्ट्रिय व्यावसायिक व्यापार गर्न अनुमति पाईदैन ।

सुनाखरीहरू अन्तर्राष्ट्रिय पुष्पखेती बजारका प्रमुख वस्तुका रूपमा विकसित भएका छन् र विकसित तथा विकासशील दुवै देशको अर्थतन्त्रमा, विशेषगरी काटिएको फूलका रूपमा, महत्वपूर्ण योगदान पुर्याएका छन् । Vanda, Cymbidium तथा Dendrobium का प्रजातिहरू कट फ्लावर उत्पादनका लागि महत्वपूर्ण वंश हुन् । Cymbidium सुनाखरीको कट फ्लावर व्यापारमा पहिलो स्थानमा रहेको र कट फ्लावर उत्पादनको करिब २.७% हिस्सा अध्ययनले देखाएको छ । हाल Dendrobium को बजार माग Cymbidium भन्दा बढी छ । Aerides, Arundina, Coelogyne, Cymbidium, Dendrobium, Paphiopedilum, Rhynchostylis तथा Vanda जस्ता जङ्गली प्रजातिबाट विश्वव्यापी रूपमा महत्वपूर्ण आधुनिक वर्ण संकर (Hybrid) विकसित भएका छन् र यी सबैको अन्तर्राष्ट्रियस्तरमा माग पनि उच्च छ ।

निष्कर्ष

नेपालका वन जङ्गल र प्राकृतिक रुपमा उम्रेका सुनाखरी (सुनगाभा) प्रजातिका वनस्पतिहरु अत्यन्तै मनमोहक र आकर्षक हुने हुदाँ पुष्प व्यवसायका लागि प्रचुर सम्भावना बोकेका छन् । नेपालको साइटिस कानुनले पनि अनुसूचीमा सूचीकृत सुनाखरी लगायतका वनस्पतिहरूको कानुनको पालना गरी सङ्कलन, उत्पादन तथा व्यापार गर्न सकिने कुरा स्पष्ट गरेको छ । यहि कानुनमा कुनै पनि सङ्कलन वा नर्सरी सञ्चालन गर्नुअघि उक्त व्यवसायिक योजना तयार गरी व्यवस्थापन निकायमा पेश गर्नु पर्दछ र वैज्ञानिक निकायको परामर्शमा व्यवस्थापन निकायले स्वीकृत गर्नुपर्छ भन्ने कुरा उल्लेख गरिएको छ । यो योजनाले प्रजातिको जनसंख्या अवस्था, जोखिम तथा दिगो उपयोगका नियमहरू जस्तैः कति मात्रामा र कसरी सङ्कलन गर्ने–निर्धारण गर्दछ । समग्रमा, नेपालको साइटिस नियमले सुनाखरी लगायतका वनस्पतिको अन्तर्राष्ट्रिय व्यापार मात्र नियन्त्रण नगरी उचित संरक्षण तथा व्यवस्थापन समेत सुनिश्चित गर्न खोजेको देखिन्छ ।

सन्दर्भ सामाग्रीहरू

वन ऐन २०७६ र वन नियमावली २०७९
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मुख्य कार्यालय: भैसीपाटी, विनयकोलनी गेट सँगै, ललितपुर

शाखा कार्यालय: आवश प्फुटबल ग्राउण्ड सँगै, भैसीपाटी, ललितपुर



हाम्रो सेवाहरु: यहाँ विभिन्न प्रकारका बोटविरुवाहरु तथा सिजनल फुल, चाईनिज दुबो साथै गार्डेन डिजाइन सम्बन्धि सम्पूर्ण काम गरिन्छ ।

गोदावरी फूल खेतीका मुख्य रोगकीराहरू र तिनको व्यवस्थापन

डा. देवराज अधिकारी [१], *, रविन्द्र थापा [२] र सुधीर श्रेष्ठ [३]
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सचिव, कृषि, पशुपन्छी, वन तथा वातावरण मन्त्रालय, हेटौंडा, नेपाल

परिचय

गोदावरी (Chrysanthemum spp.) कट फ्लावर, गमला, पुष्पगुच्छा (Bouquet), माला तथा बगैंचाको सजावट (Bedding) का लागि विश्वभरि नै लोकप्रिय एवं उच्च व्यावसायिक मूल्य भएको फूल हो । यसका आकर्षक रङ्गहरू, विविध आकार र धेरै समयसम्म ताजा रहन सक्ने क्षमताका कारण पुष्प व्यवसायमा यसको महत्त्वपूर्ण स्थान छ । गोदावरी खेती गर्दा विभिन्न प्रकारका रोगहरू तथा रस चुस्ने र पात/फूल खाने कीराहरूले ठूलो क्षति पुर्याउन सक्छन् । समयमै रोग तथा कीराको सही पहिचान गरी एकीकृत शत्रुजीव व्यवस्थापन (IPM) पद्धति अपनाउन सकिएमा बिरुवाको गुणस्तर सुधार्न, उत्पादकत्व बढाउन र व्यावसायिक लाभ हासिल गर्न सकिन्छ ।



१. बेर्ना कुहिने रोग (Dampiging off)

बेर्ना कुहिने रोग (Damping off) मुख्यतया नर्सरी अवस्थामा बिरुवालाई क्षति पुर्याउने एक विनाशकारी ढुसीजन्य (Pythium sp. / Rhizoctonia solani) समस्या हो । नर्सरी ब्याडमा बीउ उम्रिदै गर्दा वा भर्खरै माटोबाट बाहिर निस्किएका कलिला बेर्नाहरूको फेदमा यस रोगको आक्रमण हुन्छ । ढुसीको संक्रमणका कारण बेर्नाको फेद गल्ने, कालो भएर कुहिने र अन्ततः बिरुवा ढलेर मर्ने गर्दछ । व्यावसायिक रूपमा तरकारी तथा फलफूल वा फूल खेती गर्दा बेर्ना सार्ने सुरुवाती अवस्थामा यस रोगले ठूलो नोक्सानी पुर्याउन सक्ने भएकाले समयमै ध्यान दिनु आवश्यक छ । व्यवसायिक रुपमा खेती गरिने गोदावरीका जातहरुका प्रशारण कटिङ्ग विधिबाट गरिने भएकोले गोदावरीमा यो रोगको समस्या केही कम देखिएतापनि विरुवा उत्पादनको लागि नर्सरीमा राखिने कलिलो मुनाको कटिङ्गमा यो रोगको संक्रमण हुनसक्ने संभावना रहन्छ ।



व्यवस्थापन

रोगको जोखिम कम गर्न नर्सरी व्यवस्थापनमा विशेष सावधानी अपनाउनु पर्छ । नर्सरी ब्याडमा बीउ वा बिरुवा धेरै बाक्लो गरी रोप्नु हुँदैन, जसले गर्दा हावाको आवतजावत राम्रो हुन्छ र ओसिलोपना कम रहन्छ । ब्याडमा पानी जमिन दिनु हुँदैन, त्यसैले पानीको निकासको उचित व्यवस्था मिलाउनुपर्छ । यसका साथै बेर्ना तयार गर्दा सधैँ रोगरहित एवं निसङ्क्रमित माध्यम (माटो, कोकोपिट वा कम्पोष्ठ) को प्रयोग गर्नुपर्छ । पानीको राम्रो निकास एवं जराको

सहज विकासको लागि गोदावरीका कटिङ्गहरु निसंक्रमण गरिएको खस्रो बालुवामा राख्नु उपयुक्त हुन्छ । माटो/बालुवा निर्मलीकरणको लागि हाल प्रति ३ लिटर पानीमा ३५ एम एल सिल्भोक्स मिसाएर माटो/बालुवा उपचार गर्ने पद्धति प्रचलनमा रहेको छ । बिरुवाको सुरुवाती वृद्धिमा अत्यधिक नाइट्रोजनयुक्त मलको प्रयोग गर्दा डाँठहरू बढी कलिला र कमजोर भई ढुसीको संक्रमण सहजै हुने भएकाले अधिक नाइट्रोजनको प्रयोगबाट बच्नुपर्छ । रोग लाग्नै नदिन वा सुरुवाती अवस्थामै रोक्नका लागि बीउ/बेर्ना तथा माटोको उपचार गर्नु प्रभावकारी हुन्छ ।

- जैविक विषादी ट्राइकोडर्मा (Trichoderma) [FRAC Group BM02] ५ देखि १० ग्राम वा मिलि प्रति लिटर पानीमा वा कार्बेन्डाजिम [FRAC Group 1] Carbendazim 50% WP) २ ग्राम प्रति लिटर पानीका दरले घोल बनाई बेर्ना तथा माटो उपचार गर्न सकिन्छ ।
- बेर्नालाई नर्सरीबाट स्थायी ब्याड वा गमलामा सारे लगत्तै ट्राइकोडर्मा (Trichoderma) [FRAC Group BM02] ५ देखि १० ग्राम वा मिलि प्रति लिटर पानीमा वा कार्बेन्डाजिम (Carbendazim 50% WP) २ ग्राम प्रति लिटर पानीको दरले मिसाएर फेद वरिपरि ड्रेन्चिङ्ग (Drenching) गर्नुपर्छ ।
- यदि नर्सरी ब्याड वा खेतमा रोगको लक्षण देखिइहालेमा ट्राइकोडर्मा (Trichoderma) [FRAC Group BM02] ५ देखि १० ग्राम वा मिलि प्रति लिटर पानीमा वा कार्बेन्डाजिम [FRAC Group 1] + म्यानकोजेब [FRAC Group M03] (Carbendazim 12%+ Mancozeb 63 WP) २ ग्राम प्रति लिटर पानीका दरले घोल तयार गरी बिरुवाको फेद र माटो राम्ररी भिज्ने गरी ड्रेन्चिङ गर्नुपर्छ ।

२ पातको थोप्ले रोग (Black leaf spot)



पातको थोप्ले रोग (Black leaf spot) गोदावरी लगायत अन्य आलंकारिक बिरुवाहरूमा लाग्ने एक प्रमुख ढुसीजन्य समस्या हो । यो रोग विशेष गरी सेप्टोरिया प्रजातिका ढुसीहरूको आक्रमणका कारणले गर्दा लाग्दछ । उच्च आर्द्रता, बढी ओसिलोपना र हावाको संचार कम हुने ओसिलो मौसममा यो रोगको प्रकोप द्रुत गतिमा फैलिन्छ । रोगको सुरुवाती अवस्थामा बोटका तल्ला तथा पुराना पातहरूमा पानीले भिजेको जस्ता साना गोलाकार तामा वा खैरो रङ्गका दागहरू देखा पर्दछन् । समयमै नियन्त्रण नगरिएमा यी दागहरू ठूला र बेआकारका गाढा खैरो वा कालो धब्बामा परिणत हुन्छन् । यसले गर्दा पातको प्रकाश संश्लेषण प्रक्रियामा अवरोध पुग्छ, रोगी पातहरू पूर्ण रूपमा सुकेर झर्दछन् र बिरुवा कमजोर भई फूलको गुणस्तर र उत्पादनमा ठूलो ह्रास आउँछ ।

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रोगको जोखिम कम गर्न र बिरुवालाई सुरुदेखि नै बलियो बनाउन उचित बाली व्यवस्थापनमा ध्यान दिनुपर्छ। सन्तुलित रूपमा जैविक तथा रासायनिक मलखादको प्रयोग गर्ने र समयमै आवश्यकता अनुसार सिँचाइ गरी बोटलाई स्वस्थ रूपमा हुर्काउनुपर्छ । सम्भव भएसम्म रोग प्रतिरोधी वा रोग निरोधक जातहरू छनोट गरी रोपण गर्नुपर्छ । खेतबारी तथा बगैँचाको नियमित सरसफाइमा विशेष ध्यान पुऱ्याउनुपर्छ । रोगग्रस्त पातहरूलाई संकलन गरेर जलाउने वा माटोमा गाड्ने गर्नुपर्छ । साथै, माथिबाट छर्कने (Overhead) सिँचाइ बन्द गरी हजारी वा थोपा सिँचाइबाट माटोमा मात्र पानी दिने व्यवस्था मिलाउनुपर्छ, जसले गर्दा पातहरू भिज्न पाउँदैनन देखिनासाथ ढुसीनाशक विषादीको प्रयोग गरी रोगलाई फैलिनबाट रोक्नुपर्छ विषादीको घोल बनाएर छर्कन सकिन्छ ।

- म्यानकोजेब [FRAC Group M03] (Mancozeb 75% WP) २ ग्राम प्रति लिटर पानीमा मिसाएर पातहरू राम्ररी भिज्ने गरी छर्कने ।
- क्लोरोथालोनिल [FRAC Group M05] (Chlorothalonil 75% WP) २ ग्राम प्रति लिटर पानीका दरले घोल तयार गरी प्रयोग गर्ने ।

- हेक्जाकोनाजोल [FRAC Group 3] (Hexaconazole 5% EC) : २ एम.एल (मिलिलिटर) प्रतिलिटर पानीमा मिसाएर बिरुवामा छर्कने विषादी प्रयोग गर्दा एउटै विषादी लगातार प्रयोग नगरी पालैपालो परिवर्तन गरेर छर्कनु बढी प्रभावकारी हुन्छ ।

३ सेतो ढुसी/पाउडरी मिल्ड्यु (Powdery mildew)



सेतो ढुसी वा पाउडरी मिल्ड्यु (Powdery mildew) गोदावरी लगायत अन्य आलंकारिक बिरुवा तथा व्यवसायिक बालीहरूमा लाग्ने एक अत्यन्तै घातक ढुसीजन्य रोग हो । यो रोग ढुसीको संक्रमणका कारणले लाग्दछ सापेक्षिक आर्द्रता बढी भएको अवस्थामा यो ढुसीको बीजाणुहरू द्रुत गतिमा फैलन्छन् । रोगको सुरुवाती अवस्थामा पातको माथिल्लो तथा तल्लो सतहमा सेतो वा खरानी रङ्गको पाउडर/धुलो पोते जस्तो लक्षणहरू देखा पर्दछन् । रोगको प्रकोप बढ ढुसी पातबाट डाँठ, मुना र कोपिलाहरूमा समेत फैलिन्छ, जसले गर्दा पातहरू पहेँलिने, गाँठिने र सुकेर झर्ने प्रत्यक्ष असर प्रकाश संश्लेषण प्रक्रियामा पर्ने भएकाले बिरुवा कमजोर हुन्छ, फूलको आकार सानो हुन्छ र फुलिसकेका फूलहरू पनि चाँडै सुकेर जान्छन ।

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रोगको प्रकोप फैलिन नदिन र बिरुवालाई स्वस्थ राख्न बगैंचाको नियमित सरसफाइमा विशेष ध्यान दिनुपर्छ । रोग लागेका संक्रमित पातहरू, सुकेका हाँगाबिँगा र वरपरका झारपातहरू समयमै टिपेर सुरक्षित रूपमा जलाउने वा माटो मा गाड्ने गर्नुपर्छ। बोटहरू अति बाक्लो गरी रोप्नु हुँदैन । पर्याप्त दूरी कायम गर्दा हावा र घामको प्रकाश सहजै आवतजावत हुन पाउँछ, जसले आर्द्रता कम गरी ढुसी फैलन दिँदैन । साथै, छाँया परेको वा ओसिलो ठाउँभन्दा घाम लाग्ने ठाउँमा गोदावरीको खेती गर्दा यो रोगको जोखिम निकै कम हुन्छ । बगैंचा वा खेतमा रोगको सुरुवाती लक्षण देखिनासाथ प्रभावकारी ढुसीनाशक (Fungicide) विषादीको प्रयोग गरी नियन्त्रण गर्नुपर्छ । तल उल्लेख गरिएका विषादीहरू मध्ये कुनै एकको प्रयोग गरी पात र डाँठ राम्ररी भिज्ने गरी छर्कन सकिन्छ ।

- सल्फर [FRAC Group M02] (Sulphur 80% WP): १ ग्राम प्रति लिटर पानीका दरले घोल बनाएर छर्ने । (सल्फर छकँदा कडा घाम वा उच्च तापक्रम भएको समयमा छर्कन हुदैन ।)
- काराथेन [FRAC Group 29] (Dinocap 48% EC): १ देखि २ मिलिलिटर प्रति लिटर पानीमा मिसाएर प्रयोग गर्ने ।
- थायोफेनेट मिथाइल [FRAC Group 1] (Thiophanate–methyl 75% WP): १ देखि २ ग्राम प्रति लिटर पानीको दरले घोल तयार गरी छर्कने ।

रोगको प्रकोप धेरै भएमा ७ देखि १० दिनको फरकमा विषादीहरू पालैपालो फेरेर छर्कनु बढी प्रभावकारी हुन्छ ।

४ फूल कुहिने बोट्राइटिस रट (Flower rot / Botrytis rot)



फूल कुहिने वा बोट्राइटिस रट (Flower rot) गोदावरी लगायतका सजावटी फूलहरूमा देखिने एउटा अति नै विनाशकारी ढुसीजन्य रोग हो । यो रोग मुख्यतया Botrytis cinerea नामक ढुसीको संक्रमणका कारणले गर्दा लाग्दछ । विशेष गरी ओसिलो मौसम, निरन्तरको वर्षा, बढी आर्द्रता (High Humidity), र घाम कम लाग्ने ओझेल वातावरणमा यो रोगको बीजाणुहरू तीव्र गतिमा फैलिन्छन् । रोगको सुरुवाती अवस्थामा फुलिसकेका फूलका पत्रहरू (पुष्पदल/Petals) मा हल्का खैरो वा पानीले भिजेको जस्तो साना भब्बाहरू देखा पर्दछन् । अनुकूल वातावरण पाएमा यी भब्बाहरू चाँडै फैलिएर सिङ्गो फूललाई नै कुहाउँछन् र भब्बामाथि कै

लो-खरानी रङ्गको ढुसीको तह देखा पर्दछ । यसले गर्दा फूलको प्राकृतिक सौन्दर्य नष्ट भई व्यावसायिक विक्रीयोग्य रहँदैन ।

व्यवस्थापन

रोगको प्रकोप फैलिन नदिन र पूर्वसावधानी अपनाउन बगैचा तथा ग्रिनहाउसको सरसफाइमा विशेष ध्यान दिनुपर्छ । रोग लागेका, मरेका वा सुकेका हाँगाबिँगा, पातहरू र कुहिएका फूलहरूलाई नियमित रूपमा टिपेर बोट तथा खेती वरपरबाट हटाई सुरक्षित ठाउँमा जलाउने वा माटोमा गाड्ने गर्नुपर्छ । बिरुवाहरू धेरै बाक्लो गरी नरोप्ने र ग्रिनहाउसभित्र भेन्टिलेसन (हावाको संचार) को राम्रो प्रबन्ध मिलाउने, जसले गर्दा बोट वरपरको आर्द्रता कम हुन मद्दत पुग्छ । माथिबाट छर्कने (Overhead) सिँचाइ बन्द गरी फेदमा मात्र पानी दिने व्यवस्था मिलाउनुपर्छ, जसले गर्दा फूलका पत्रहरू भिज्न पाउँदैनन् । रोगको प्रकोप देखिनासाथ वा रोकथामका लागि ढुसीनाशक विषादीको प्रयोग गरी नियन्त्रण गर्न सकिन्छ ।

- म्यानकोजेब [FRAC Group M03] (Mancozeb 75% WP) २ ग्राम प्रति लिटर पानीका दरले घोल तयार गरी बोट र फूलहरू राम्ररी भिज्ने गरी छर्कने ।
- एजोक्सिस्ट्रोबिन [FRAC Group 11] (Azoxystrobin 23% SC) १ एमएल (मिलिलिटर) प्रति लिटर पानीमा मिसाएर छर्कने ।
- क्लोरोथालोनिल [FRAC Group M05%] (Chlorothalonil 75% WP): २ ग्राम प्रति लिटर पानीमा मिसाएर प्रयोग गर्ने ।

रोगको सङ्क्रमण बढी भएको अवस्थामा ७ देखि १० दिनको फरकमा विषादीहरू पालैपालो परिवर्तन गरेर छर्कनु बढी प्रभावकारी हुन्छ ।

५ सिन्दुरे रोग (Rusts)



गोदावरी फूलमा लाग्ने सिन्दुरे रोग (Rust) एक प्रमुख दुसीजन्य (Puccinia spp.) समस्या हो ।

(क) खैरो सिन्दुरे रोग सुरुमा पातको माथिल्लो सतहमा हल्का पहेंलो दाग देखिन्छ भने पातको तल्लो सतहमा मसिना गिर्खाहरू (Pustules) बन्दछन् । यी गिर्खाहरू फुटेर रातो-खैरो रङ्गको धुलो/पाउडर बाहिर निस्कन्छ । यसको लक्षण डाँठमा भने देखिदैन ।

(ख) सेतो सिन्दुरे रोगको सुरुवाती लक्षण खैरो सिन्दुरे जस्तै भए पनि पातको तल्लो सतहमा गुलाबी गिर्खाहरू देखा पर्छन्, जुन पछि सेतो रङ्गमा परिणत हुन्छन् । यो रोग बढी आक्रामक हुन्छ र यसको लक्षण पातका साथै डाँठ र फूलमा समेत फैलिन सक्छ । विशेष गरी विरुवाहरू धेरै बाक्लो गरी रोप्दा वा गमलाहरू नजिक-नजिक राख्दा, वायुमण्डलमा आर्द्रता बढी भएको अवस्थामा यो रोग द्रुत गतिमा फैलन्छ ।

व्यवस्थापन

सधै निरोगी र रोगमुक्त, स्वस्थ माउबोट वा बेर्ना मात्र छनौट गरि रोपणका लागि प्रयोग गर्ने । विरुवा रोप्दा धेरै बाक्लो नरोप्ने र गमलामा खेती गरिएको छ भने एक-अर्कासँग नछुने गरी पर्याप्त दूरी कायम गर्ने, जसले गर्दा हावाको आउजाउ राम्रो हुन्छ र ओस कम रहन्छ । रोगको प्रकोप रोकथाम वा नियन्त्रणका लागि तल उल्लेख गरिएका कुनै एक ढुसीनाशक विषादीको घोल बनाई पातको तल्लो र माथिल्लो दुवै सतह राम्ररी भिज्ने गरी छर्कनुपर्छ ।

- म्यानकोजेब [FRAC Group M03] (Mancozeb 75% WP) २ ग्राम प्रति लिटर पानीमा मिसाएर छर्ने ।
- क्लोरोथालोनिल [FRAC Group M05] (Chlorothalonil 75% WP) २ ग्राम प्रति लिटर पानीका दरले प्रयोग गर्ने ।
- टेबुकोनाजोल [FRAC Group 3] (Tebuconazole 25.9 EC) १ देखि २ मि.लि. प्रति लिटर पानीमा मिसाएर छर्कने ।

- टेबुकोनाजोल [FRAC Group 3] + ट्राइफ्लोक्सिस्ट्रोबिन [FRAC Group 11) (Tebuconazole 50% + Trifloxystrobin 25% WP): १ ग्राम प्रति लिटर पानीका दरले घोल बनाएर प्रयोग गर्ने ।

६ ओइलाउने रोग (Wilt)





गोदावरी खेतीमा देखिने ओइलाउने रोग (Wilt) एक विनाशकारी समस्या हो । यो रोग मुख्यतया माटोमा आश्रित दुसीहरू (Soil–borne fungi) को आक्रमणका कारणले लाग्दछ । साथै व्याक्टेरियाले समेत ओइलाउने रोग लाग्न सक्दछ । फ्युजारियम ओइलाउने रोग विशेष गरी न्यानो वा गरम मौसम र तापक्रम बढी भएको क्षेत्रमा तीव्र रूपमा फैलिन्छ । यस रोगको आक्रमण हुँदा बिरुवाका तल्ला पातहरू पहेंलिन र ओइलाउन थाल्छन् । बिस्तारै यो लक्षण माथितिर सर्दै जान्छ र बिरुवाको कुनै एक भाग वा सिनो बोटनै सुकेर मर्छ । रोग सङ्क्रमित बिरुवाको डाँठ तेर्सो काटेर भित्री भाग (Xylem Vessel) हेरेमा कालो वा खैरो धर्सा/दाग देखिन्छ । भर्टिसिलियम ओइलाउने रोग सङ्क्रमण भएमा विरुवा फेदतर्फबाट माथितिर मर्दै जान्छ । सङ्क्रमित पातहरूमा नसाहरूको बीचको भाग पहेंलिने, खैरो हुने र सुक्ने गर्दछ । बोट पूर्ण रूपमा नओइलाए पनि बिरुवा पुड्को हुने, वृद्धि विकास रोकिने र फूल फुल्न नसक्ने हुन्छ । यो समस्या संरक्षित संरचना (ग्रिनहाउस) भन्दा खुल्ला जमिनमा लगाइएको गोदावरीमा बढी देखिन्छ ।

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गोदावरीको बेर्ना वा कटिन रोप्नुअघि माटोलाई तातो घाममा सोलेराइजेसन (Solarization) गरेर वा उपयुक्त ढुसीनाशक रसायन/जैविक विषादीले उपचार गरेर मात्र रोप्नुपर्छ । कटिङ्ग वा बेर्ना तयार पार्दा सधै रोगमुक्त, निरोगी र स्वस्थ माउबोटबाट मात्र कटिङ्स लिनुपर्छ । सङ्क्रमित जमिनमा निरन्तर गोदावरी नलगाई बाली चक्र (Crop rotation) अपनाउनु उपयोगी हुन्छ । ओइलाउने रोग माटोबाट फैलिने भएकाले बोटमा छर्कनुको साटो फेदको माटो भिज्ने गरी ड्रेन्चिङ (Drenching) गर्नु प्रभावकारी हुन्छ ।

- जैविक विषादी ट्राइकोडर्मा [FRAC Group BM02] (Trichoderma) : ५ देखि १० ग्रा वा मिलि प्रति लिटर पानीका दरले घोल बनाई बेर्ना तथा माटो उपचार गर्न सकिन्छ ।
- कार्बेन्डाजिम [FRAC Group 1] (Carbendazim 50% WP): १-२ ग्राम प्रति लिटर पानीका दरले घोल तयार गरी बिरुवाको फेद वरिपरि ड्रेन्चिङ गर्ने ।
- एजोक्सिस्ट्रोबिन [FRAC Group 11) (Azoxystrobin 23% SC): १ एमएल (मिलिलिटर) प्रति लिटर पानीमा मिसाएर बिरुवाको फेद र माटो राम्ररी भिज्ने गरी ड्रेन्चिङ गर्ने ।



७ लाही कीरा (Aphids)

लाही कीरा (Aphids) गोदावरी लगायत आलंकारिक विरुवाहरूमा लाग्ने एक प्रमुख रस चुस्ने कीरा हो । यी अति मसिना कीराहरू समूहमा बस्न मन पराउँछन् । लाहीका माउ र बच्चा (Nymphs) दुवैले गोदावरीका कलिला पातहरू, डाँठ, कोपिला र फूलका पुष्पदलहरूको तल्लो सतहमा बसेर निरन्तर रस चुस्दछन् । कीराको संख्या बढी हुँदा डाँठ र पातहरू पूरै ढाकिन्छन्, जसले गर्दा बोटको वृद्धि

विकास रोकिन्छ, पातहरू दोब्रिन्छन् वा विकृत हुन्छन् र फूलको प्राकृतिक रूप तथा सौन्दर्य नष्ट हुन्छ । यसका साथै लाहीले रस चुस्ने क्रममा गुलियो पदार्थ (Honeydew) उत्सर्जन गर्दछ, जसमा पछि कालो ढुसी (Sooty mold) ताँसिएर प्रकाश संश्लेषणमा समेत बाधा पुग्छ ।

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- प्रकृतिमा पाइने मित्रजीवहरू जस्तै लेडि बर्ड बिटल (Lady–bird beetle), कीराहरूले लाहीलाई खाएर प्राकृतिक रूपमै नियन्त्रण गर्दछन् । त्यसैले यस्ता मित्रजीवहरूको संरक्षण गर्नुपर्छ ।
- जैविक विषादी *Verticillium lecanii* [IRAC Group UNM] 1.15% WP ३ ग्राम प्रति लिटर पानीमा मिसाएर छर्कंदा लाही नियन्त्रणमा सहयोग पुग्छ ।
- स्थानीय स्तरमा सहजै उपलब्ध हुने घरेलु उपचार गहुँत पानी, सुर्तीको झोल, झोलमल, खरानी तथा मट्टितेलको हल्का सम्मिश्रण (Soap–kerosene emulsion) प्रयोग गरेर लाही नियन्त्रण गर्न सकिन्छ ।
- वनस्पतिजन्य विषादी एजाडिरिक्टिन [IRAC Group UN] (Azadirachtin 0.03% EC/1500ppm) ३ देखि ५ एमएल प्रति लिटर पानीमा मिसाएर छर्कनुपर्छ ।

प्रकोप धेरै बढेको अवस्थामा दैहिक (Systemic) गुण भएका कीटनाशक विषादीहरू प्रयोग गर्न सकिन्छ, जसलाई बिरुवाले सोसेर लिने हुँदा रस चुस्ने कीराहरू छिट्टै नष्ट हुन्छन् ।

- डाइमेथोएट [IRAC Group 1B) (Dimethoate 30% EC) १ देखि २ एमएल प्रति लिटर (वा ५ लिटर पानीमा ५-१० एमएल) मिसाएर छर्कने ।
- इमिडाक्लोप्रिड [IRAC Group 4] (Imidacloprid 17.8% SL) १ एमएल प्रति ३ देखि ५ लिटर पानीका दरले घोल तयार गरी बोट राम्ररी भिज्ने गरी छर्कने ।

८ गबारो लाभ्रे (Borer)



गोदावरी फूल खेतीमा गवारो तथा विभिन्न प्रजातिका लाभ्रे / गबारोहरू (Spodoptera spp., Helicoverpa spp.) आदि ले बालीको प्राथमिक अवस्था देखि फुलिसकेको चरणसम्म गम्भीर क्षति पुऱ्याउने गर्दछन् । वयस्क पोथी पुतलीले फूलको कोपिला, कलिला पात र पुष्पदल (Petals) मा अण्डा पार्दछ । अण्डाबाट निस्किएका लाभ्रे वा गवारो (Larvae) हरू अत्यन्तै भोका हुन्छन् र तिनले सुरुमा कलिला पातहरू टोकेर खान्छन् । बिस्तारै यिनीहरूले फूलका कोपिला र फुलिसकेका फूलका पत्रहरू खाएर प्वाल पारिदिन्छन् । लाभ्रेको आक्रमणले गर्दा कोपिला फक्रन पाउँदैन, फूलको आकृति बिग्रिन्छ र बजारमा बिक्रीयोग्य रहँदैन ।

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बोट वरपरका झारपातहरू नियमित रूपमा सफा गर्ने र कीराले खाएका वा क्षति पुर्या एका कोपिला तथा पातहरू टिपेर नष्ट गर्ने । खेतबारी/बगैंचामा वयस्क पोथी/भाले पुतलीहरूको उपस्थिति थाहा पाउन र संख्या नियन्त्रण गर्न प्रकाश पासो (Light trap) वा पारा-फेरोमोन पासो (Para-pheromone trap/Heli-lure, Spodo-lure) को प्रयोग गर्ने । सुरुवाती अवस्थामा पात वा कोपिलामा देखिने लाभ्रेहरूलाई हातले टिपेर नष्ट गर्न सकिन्छ ।

- घरेलु रूपमा तयार पारिने गहुँत-पानी (१:५ को अनुपातमा), सुर्तीको झोल, तथा स्थानीय झोलमलको प्रयोग गरी लाभ्रेलाई भगाउन वा क्षति रोक्न सकिन्छ ।
- वानस्पतिक विषादी एजाडिरिक्टिन [IRAC Group UN] (Azadirachtin) ३ देखि ५ एमएल प्रति लिटर पानीमा मिसाएर छर्कनुपर्छ, जसले लाभ्रेको भोजन प्रक्रियामा अवरोध पुर्याीउँछ ।
- जैविक कीटनाशक *Bacillus thuringiensis* (Bt) [IRAC Group 11] २ ग्राम प्रति लिटर पानीमा मिसाएर

छर्कंदा साना लाभ्रेहरू प्रभावकारी रूपमा नष्ट हुन्छन् ।

- प्रकोप तीव्र रूपमा बढेको अवस्थामा रसायनिक कीटनाशक विषादीहरू प्रयोग गर्न सकिन्छ । जस्तैः इमामेक्टिन बेन्जोएट [IRAC Group 6] (Emamectin Benzoate 5% SG) १ ग्राम वा मिलि प्रति ३ देखि ५ लिटर पानीमा मिसाएर प्रयोग गर्ने ।

९. थ्रिप्स (Thrips)



थ्रिप्स (Thrips) गोदावरी लगायतका सजावटी फूलहरूमा गम्भीर नोक्सानी पुर्यासउने अति मसिना कीरा हुन् । नाङ्गो आँखाले सजिलै ठम्याउन नसकिने भएकाले बोट वा फूलमा क्षति देखिन थालेपछि मात्र यसको उपस्थितिको थाहा हुन्छ । यी कीराहरू सेतो, पहेंलोदेखि काला रङ्गका हुन्छन् र प्रायः फूलका पत्रहरू, कोपिला र पातको फेदमा लुकेर बस्छन् । यिनीहरूले बोटको कमिला तथा बढ्ने भागहरूमा टोकेर र कोत्तरेर रस चुस्दछन् । यसको आक्रमणका कारण पातहरू छिरबिरे, दोब्रिएका र विकृत हुन्छन् भने फुलिसकेका फूलका पुष्पदल (Petals) हरूमा खैरा वा सेता धब्बाहरू परेका देखिन्छन् । बढी प्रकोप भएमा फूल डढेको जस्तो देखिन्छ र समय नपुग्दै फक्रन नपाई झर्दछ । थ्रिप्सले विशेष गरी गरम, सुक्खा, धुलो र धुमैलो वातावरण मनपराउने भएकाले सुक्खा मौसममा यसको प्रकोप तीव्र रूपमा बढ्दछ ।

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खेतबारी वा ग्रिनहाउसभित्र नियमित रूपमा गोडमेल गरी झारपात नियन्त्रण गर्ने र खसेका वा रोगी पातहरू, फूल र कोपिलाहरू सङ्कलन गरेर नष्ट गर्ने। थ्रिप्सको उपस्थिति र संख्या अनुगमन गर्नका लागि बगैंचा वा ग्रिनहाउसभित्र निलो टाँसिने पासो (Blue sticky traps) ठाउँ-ठाउँमा झुण्ड्याउने । थ्रिप्सले आफ्नो जीवनचक्रको अचल/प्युपावस्था माटोमा गुजारिने भएकाले माटोमा रहेका प्युपा नष्ट गर्न माटो उपचार गर्नु पर्दछ । थ्रिप्समा विषादी विरुद्ध प्रतिरोधात्मक क्षमता छिटो विकास हुने भएकाले एउटै विषादी लगातार प्रयोग नगरी देहाय बमोजिमका विषादीहरू ७-१० दिनको फरकमा पालैपालो परिवर्तन गरेर छर्कनुपर्छ ।

- साइरोमाजिन [IRAC Group 17] (Cyromazine 10% WP): १ ग्राम प्रति लिटर पानीमा मिसाएर छर्कने ।
- एवामेक्टिन [IRAC Group 6) (Abamectin 11.9% EC): ०.५ एमएल प्रति लिटर पानीका दरले घोल बनाएर प्रयोग गर्ने ।
- थायोमेथोक्जाम [IRAC Group 4A] (Thiamethoxam 25% WP): १ ग्राम प्रति ३ देखि ५ लिटर पानीमा मिसाएर छर्कने ।
- बाइफेन्थ्रिन [IRAC Group 3] (Bifenthrin 10% EC): १ देखि २ एमएल प्रति लिटर पानीका दरले घोल तयार गरी प्रयोग गर्ने ।
- फिप्रोनिल [IRAC Group 2B] (Fipronil 5% SC): १.५ एमएल प्रति लिटर पानीमा मिसाएर बोट राम्ररी भिज्ने गरी छर्कने ।

१०. पातमा लेख्ने कीरा (Leaf miner)



पातमा लेख्ने कीरा (Leaf miner) गोदावरी लगायतका सजावटी बिरुवाहरूमा ठूलो क्षति पुया-उने एक प्रमुख कीरा हो । यस कीराको पोथी भिँगाले पातको माथिल्लो वा तल्लो सतहमा साना-साना प्वाल पारेर फूल पार्दछ । अण्डाबाट निस्किएका मसिना लार्भाहरू पातको दुई सतह (माथिल्लो र तल्लो छाला) को बीचमा छिरेर भित्री हरियो भाग (Mesophyll) खाँदै अगाडि बढ्छन् । लार्भा खाने क्रममा अगाडि बढ्दा पातको बाहिरबाट सेतो वा सेतो पहेंलो नागबेली (सुरुङ्ग) जस्तै धर्साहरू/अक्षर लेखेको जस्तो स्पष्ट देखिन्छ । पूर्ण रूपमा हुर्केका लार्भाहरू पातबाट झरेर माटोमा वा सुकेका पातहरूमा प्युपावस्था (Pupation) मा बस्दछन् । कीराले बढी ग्रसित पारेका पातहरूमा

प्रकाश संश्लेषण प्रक्रिया अवरुद्ध हुन्छ, जसले गर्दा पातहरू सुकेर, चाउरिएर झर्दछन् र बिरुवा कमजोर भई फूलको गुणस्तर बिग्रिन्छ ।



व्यवस्थापन

वयस्क भिंगा/कीराहरूलाई आकर्षित गरी मार्नका लागि बगैंचा वा ग्रिनहाउसभित्र पहेंलो टाँसिने पासो (Yellow sticky traps) ठाउँ-ठाउँमा झुण्ड्याइदिने । सुरुवाती अवस्थामा कीरा वा सुरुङ्ग देखिएका पातहरूलाई हातले टिपेर तुरुन्तै सुरक्षित ठाउँमा लैजाने र जलाएर वा माटोमा गाडेर नष्ट गर्ने । कीराको फरक-फरक शारीरिक अवस्था (लार्भा तथा वयस्क) अनुसार देहाय बमोजिमका कीटनाशक विषादीहरू प्रयोग गर्नुपर्छ ।

लार्भा नियन्त्रणका लागि (Larvicides):

- एबामेक्टिन [IRAC Group 6) (Abamectin 10% EC) ०.४ मि.लि. प्रति लिटर पानीमा मिसाएर छर्ने ।
- कार्टाप हाइड्रोक्लोराइड [IRAC Group 14] (Cartap Hydrochloride 50% SP) १ ग्राम प्रति लिटर पानीमा मिसाई छर्ने ।
- साइरोमाइजिन [IRAC Group 17] (Cyromazine 10% WP) १ ग्राम प्रति लिटर पानीका दरले घोल तयार गरी छर्ने ।
- वयस्क भिंगा नियन्त्रणका लागि Adulticides) साइपरमेथ्रिन [IRAC Group 3A] (Cypermethrin 10% EC) १ मि.लि. प्रति लिटर पानीका दरले मिसाएर बोट राम्ररी भिज्ने गरी छर्कने ।

११. सेतो भिंगा (White fly)



गोदावरी फूल खेतीमा सेतो भिंगा एक विनाशकारी रसचुस्ने सेतो भिंगा (White fly) कीरा हो, जसका वयस्कहरू साना, सेतो पखेटा भएका हुन्छन् भने तिनका शिशुकीट/बच्चाहरू पातको तल्लो सतहमा रहन्छन् । यसका वयस्क र शिशुकीट/बच्चाहरू दुवैले पातको तल्लो भागबाट रस चुस्दा पात पहेँलिएर सुक्ने, बिरुवाको वृद्धि रोकिने तथा यसले उत्सर्जन गर्ने गुलियो पदार्थ (Honeydew) मा कालो ढुसी (Sooty mold) उम्रिएर प्रकाश संश्लेषण प्रक्रिया अवरुद्ध हुन्छ; साथै यसले घातक भाइरस रोगहरू समेत फैलाउन सक्दछ ।

व्यवस्थापन

यसको एकीकृत व्यवस्थापनका लागि खेतबारी र प्लष्टिक घरको सरसफाइ गर्ने, सङ्क्रमित पातहरू टिपेर नष्ट गर्ने, कीरा रोक्ने जाली प्रयोग गर्ने, कीराको अनुगमन र व्यवस्थापनका लागि पहेँलो टाँसिने पासो (Yellow sticky trap) झुन्ड्याउने गर्नु पर्दछ ।

वनस्पतिजन्य विषादी एजाडिरिक्टिन [IRAC Group UN] (Azadirachtin 0.03% EC/1500ppm) ३ देखि ५ एमएल प्रति लिटर पानीमा मिसाएर छर्कनुपर्छ ।

प्रकोप धेरै बढेको अवस्थामा दैहिक (Systemic) गुण भएका कीटनाशक विषादीहरू प्रयोग गर्न सकिन्छ, जसलाई बिरुवाले सोसेर लिने हुँदा रस चुस्ने कीराहरू छिट्टै नष्ट हुन्छन् ।

- डाइमेथोएट [IRAC Group 1B] (Dimethoate 30% EC): १ देखि २ एमएल प्रति लिटर (वा ५ लिटर पानीमा ५-१० एमएल) मिसाएर छर्कने ।
- इमिडाक्लोप्रिड [IRAC Group 4] (Imidacloprid 17.8% SL): १ एमएल प्रति ३ देखि ५ लिटर पानीका दरले घोल तयार गरी बोट राम्ररी भिज्ने गरी छर्कने ।

बोटबिरुवामा रासायनिक विषादी प्रयोग गर्दा प्रयोगकर्ताको स्वास्थमा हुने जोखिमबाट बच्न सुरक्षित पहिरन लगाउनु अत्यावश्यक हुन्छ । साथै, पर्यावरण र मित्रजीवहरुलाई बचाउन एकीकृत शत्रुजीव व्यवस्थापन (IPM) लाई प्राथमिकता दिँदै विषादीलाई अन्तिम विकल्पका रूपमा सुरक्षित तवरले प्रयोग गर्नु बुद्धिमानी हुन्छ ।



फङ्गिसाइड्स रेजिस्टेन्स एक्शन कमिटी (FRAC) को सूचीले प्रतिरोध जोखिम व्यवस्थापन गर्न, उत्पादन प्रभावकारीतालाई लम्ब्याउन र स्प्रे रोटेशनलाई मार्गदर्शन गर्न कार्य प्रकृति अनुसार फङ्गिसाइडहरूलाई वर्गीकृत गर्दछ । सक्रिय तत्वहरू पहिचान गरेर, यसले प्रयोगकर्ताहरूलाई ढुसीनाशक रसायनहरुलाई आलोपालो प्रयोग मद्दत गर्दछ, रोगकारक शुक्ष्मजीवाणुहरूलाई विशिष्ट फङ्गिसाइडहरूको प्रतिरोध विकास गर्नबाट रोक्छ । कीटनाशक प्रतिरोध कार्य समिति (IRAC) सूची एक निश्चित, विश्वव्यापी रूपमा मान्यता प्राप्त वर्गीकरण हो जुन कीटनाशक प्रतिरोध व्यवस्थापन र रोकथाम गर्न तयार गरिएको हो । यसले कीटनाशकहरूलाई तिनीहरूको कार्य प्रकृति (MoA) को आधारमा संख्यात्मक समूहहरूमा वर्गीकृत गर्दछ, जसले प्रयोगकर्ताहरूलाई उत्पादन प्रभावकारिता कायम राख्न र प्रतिरोध विकासलाई रोक्न कीट नियन्त्रणमा विभिन्न रासायनिक वर्गहरू आलोपालो प्रयोग गर्न अनुमति दिन्छ ।

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4th FAN INTERNATIONAL & 28th NATIONAL FLORA EXPO 2027

March 25-28, 2027 | Chaitra 11-14, 2083
Bhrikutimandap Exhibition Hall, Kathmandu, Nepal

Floriculture Association Nepal (FAN) proudly presents the 4th FAN International & 28th National Flora Expo-2027 in Kathmandu, Nepal. The Expo will bring together national and international floriculture businesses, producers, suppliers, buyers, exporters, and investors to explore business opportunities, exchange knowledge, and build lasting partnerships. It aims to promote Nepal's floriculture sector, encourage trade and investment, and strengthen international collaboration.

The event is co-organized by Bagmati Province Government, Ministry of Agriculture, Livestock, Forest and Environment.

THE EXPO AT A GLANCE

Particulars	Details
Event	4th FAN International & 28th National Flora Expo–2027
Date	March 25-28, 2027
Nepali Date	Chaitra 11-14, 2083
Venue	Bhrikutimandap Exhibition Hall
City, Country	Kathmandu, Nepal
Duration	4 Days
Focus	Floriculture, Horticulture, Technology, Investment & Trade
Participation	National & International
Format	Exhibition + B2B + Conference + Demonstration + Networking
No. of. Stalls	100+

EXPO VISITORS

Visitor Category	Expected Number
Domestic Visitors	65,000
Foreign Visitors	1,000

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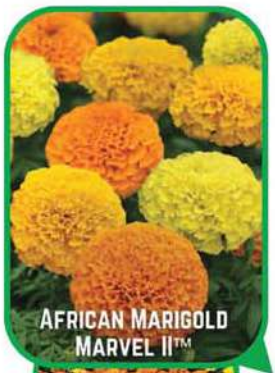







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