

Vegetable Seed Production under Precision and Protected Structures

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Abstract

Vegetable seeds are considered as high-value low volume commodities. Quality vegetable seed is vital for increased vegetable productivity. In Nepal vegetable seed production under open field possess challenges like maintaining isolation distances, impacts from biotic and abiotic stress and to avoid this seed production using precise climate and nutrient control under protected structure is the best identified strategy. Precise farming using protected structures allows quality seed production within a definite time and the production of hybrid seed of vegetable is considered profitable ventures in an international context. Among the total of 277 vegetable varieties registered in Nepal 65.7% are of hybrids. The exact information on seed production amount and area under protected structure is not officially documented but the production of tomato hybrid seeds using Bamboo Plastic Houses (BPH) and Naturally Ventilated Greenhouses (NVGs) is common in Nepalese context. There is a huge scope for producing quality hybrid seeds for import substitution and export promotion for fruit vegetables using precision and protected farming in Nepalese context. Appropriate research, technological support and facilitation from three tiers of government are needed to promote seed production as a profitable enterprise under precision and protected structure.

Keywords: Precision, Protected Structures, Vegetable Seeds

Introduction

Precision and protected farming is a holistic farming system commonly adopted in the world which combines information and communication technology along with crop management practices for maximizing efficiency of production. Precision and protected horticulture is a key for increasing agriculture production and productivity for various types of growing structures in the current world (Atreya et al.,2020). The Distinctness, Uniformity and Stability (DUS) are the major judgment criteria for the quality of any types of seeds to judge this seed should be free from disease, seed vigour and genetic purity (Singh and Tomor,2015). Maintaining DUS quality of the vegetable seed is a key issues globally compared to other ventures like fresh production.

The open field production of vegetable seeds poses several biotic and abiotic challenges like isolation, disease and pest and climatic risks. Compared to open fields, protected cultivation with precise climate and nutrient management delivers high yield and quality attributes. In India, lots of research has been done and this technology is verified for yield and quality attributes (Singh and Tomar,2015), however the protected environment is only limited to the seed production of hybrid tomato in Nepal and around 10 private companies are involved in the hybrid seed production of Srijana tomato variety with limited public institutions involvement (Thapa Magar and Gauchan ,2016). The protected seed production is limited to only hybrid tomato production using BPH and NVGs in most of cases in Nepal.

Each year the demand of quality tomato seed is escalating with limited supply. During the year 2020 the total demand of vegetable seed was 1745 Mt, while production was limited to 475 Mt (Paudel et al.,2020), most of the productions are of open pollinated vegetable seeds. Likewise, the import of vegetable seed is increasing year after year- 160.62 Mt in 2075/76 BS and 218.4 Mt during 2079/80 BS (SQCC,2079/80) and among the total import the share of hybrid variety is around 23%. Among the 277 vegetable varieties registered in Nepal, 182 varieties (65.7%) are of hybrids. The government of Nepal has implemented seed act, seed regulations to facilitate quality seed production and it has also formulated national seed vision for the production of domestic hybrid vegetable seeds (Timsina et al.,2015). Likewise, the national seed policy 2000, national agriculture policy 2004 and other plans and policies along with research and development institutions are in place to promote the production and use of quality seeds in Nepal.

There is a huge potentiality for domestic vegetable seed production using precision farming and protected structures. Seed production under protected structures has been identified as an economical and profitable strategy with the highest possible quality (Singh and Tomor,2015). Different types of protected structures are highly recommended for the hybrid seed production of vegetables (Srinivasalu et al.,2017). Plastic houses using low-cost frames, like bamboo and net houses, are widely used structures for seed production, followed by NVGs in Nepal. While a few innovative ideas have been adopted for precision farming, the majority of the farmers use drip irrigation, but are limited to the use of water only. There are opportunities to use temperature and humidity control along with precise nutrient application for vegetable seed production in Nepal, as temperature, humidity, and balanced nutrition are the keys to quality vegetable seed production. In tomato seed production, the stigma receptivity, pollen viability, fruit set and yield are limited by temperature and humidity (Singh and Tomar,2015).

Conceptual Framework of the Study

The main objective of this study is to explore the possibility of seed production using precision and protected farming in Nepal based on the review of a similar scenario that can be applied in our context. This paper is prepared based on the review of available practices for seed production, especially focusing on the Indian context and experiences of seed production activities in Nepal. For reviewing the literature, mostly the literature from the Indian conditions similar to Nepalese agro ecology and socio-economy, taken as the references and conclusions and future courses of actions were prepared based on those reviews and seed production scenarios in Nepal (Figure 1)

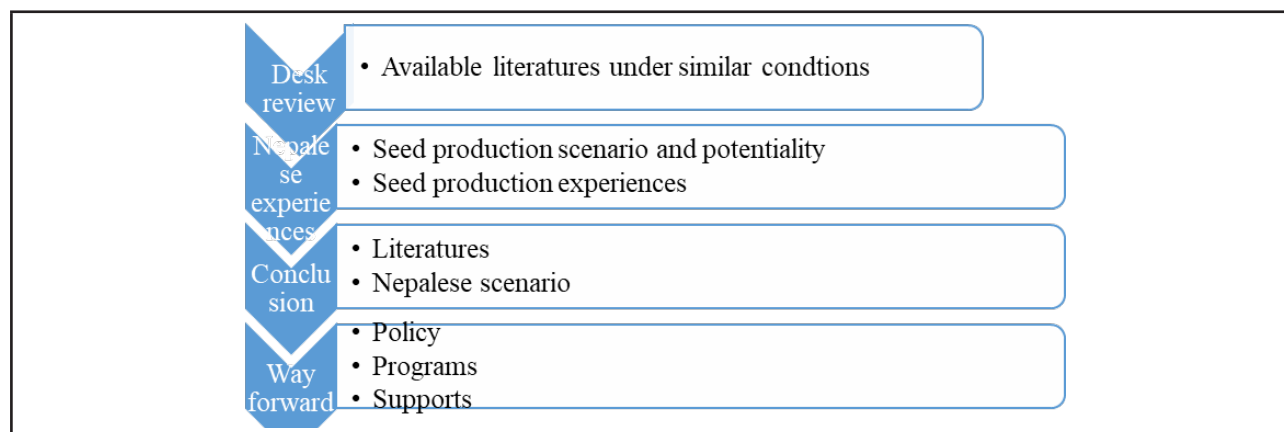


Figure 1: Broad framework for the study

Results

The results in the tabular forms are presented based on the desk review of different studies done in Indian conditions for producing vegetable seeds using different structures and nutrient management practices so that those can be replicated in Nepalese context due to the agro ecological and socioeconomic similarities.

1. Some results of protected seed production from Indian contexts

In India, Net houses and NVGs are common for the seed production practices for the vegetables. The results of vegetable seed production using net house and naturally ventilated plastic house under Indian conditions is presented in Table 1.

Table 1: Results on Protected Vegetable Seed Production

S.N.	Commodities/Conditions	Results	References
1	Pumpkin(<i>Cucurbita moschata</i>) - net house	The fruit set percentage and time doubled than open field	Singh and Tomar,2015
2	Bitter gourd(<i>Momordica charantina</i>)-net house	High seed yield and no incidence of YMV and fruit fly	Singh and Tomar,2015
3	Summer suash (<i>Cucurbita pepo</i>)-net house	High seed yield with better quality and no incidence of mosaic virus	Singh and Tomar,2015
4	Cucumber(<i>Cucumis sativus</i>)- net house and naturally ventilated plastic house(NVPH)	Significantly high seed yield with good germination and vigor with no incidence of disease in autumn season	Singh and Tomar,2015

5	Bottle gourd (<i>Lagenaria siceraria</i>)- net house	High yield, germination and vigour	Singh and Tomar,2015
6	Tomato (<i>Solanum lycopersicum</i>)- Naturally ventilated green house	Stigma receptivity, pollen viability, fruit set and yield limited by temperature and humidity. Low TYLCV. High yield due to prolonged fruiting time	Singh and Tomar,2015
7	Capsicum (<i>Capsicum annum</i>)- net house and NVPH	High yield and quality	Singh and Tomar,2015
8	Brinjal (<i>Solanum melongena</i>) -Net house	Low incidence of fruit and shoot borer, better seed yield and quality. Longer stigma receptivity and pollen viability	Singh and Tomar,2015

2. Nepalese context

The precision and protected farming for fresh vegetable production has been adopted in Nepal for fresh production since 1.5 decades so there have been limited efforts on protected and precision seed production technologies in Nepal. The research institution- Nepal Agriculture Research Council (NARC) is solely responsible for parental line and breeder seed production and distribution to the seed producers. Some NARC Centers, like Khumaltar, Malepatan and government farms like Vegetable Crops Development Centre Khumaltar, Panchkhal and Rukum are involved in tomato hybrid seed production in Nepal. A case example of vegetable seed production under a protected structure is given in Table 2.

Table 2: Case example of vegetable seed production under protected structures Vegetable Crops Development Centre (VCDC), Nepal

S.N.	Commodities/Crops	Results	References
1	Srjana hybrid tomato under galvanised iron (GI) plastic house	The highest seed recovery (7gram/kg of fresh fruit) was observed during Ashoj to Mangshir (September to December), while low seed recovery (4.5 gram/ Kg of fresh fruit) was observed during Baishakh to Shrawan (April to July)	Field level experiences at Vegetable Crops Development Centre, Khumaltar, Lalitpur
2	Khumal Jyapu variety of cauliflower under net house	The highest test weight of seed was observed, but seed production was reduced due to lack of the pollinizers'	Default-search

Discussion

There are a lot of works done focusing on precision and protected seed production at a global and Indian context but limited evidence was found in the Nepalese contexts. The research and production data/ evidences from the Indian contexts shown in Table 1 justifies the importance of precision and protected structures for high value vegetable seed production. Likewise, the cases from Vegetable Crops Development Center as shown in Table 2 also justifies the importance and potentiality of seed production under precision and protected conditions.

The insect proof net houses are recommended for virus free production, protection from insects/pest, protection from mild frost (Singh et al.,2013). The major advantages of seed production under protected conditions are: 2-4 times more yield than open field; quality, reduced isolation, flowering synchronization, maximum planting population, protection from adverse climate, maintain field standard, judicious use of inputs and ultimately extended seed viability and vigor through nutrient management (Singh and Tomar,2015). There is a clear gap of research activities focusing on seed production under protected structures as this technology is commonly used in offseason vegetable production in Nepal. The BPH along with drip for irrigation and fertigation and plastic mulching are commonly used low cost technology for producing hybrid tomato seeds in Nepal.

In Nepal the government has gave thrust for the precision and protected farming for increasing availability of fresh vegetable through the focused program on potential district by providing 50% subsidy on structures since more than a decade. Now the provincial and local government are promoting those technologies through their regular annual programs. The National Agriculture Policy of Nepal (NAP), 2004, Agriculture Development Strategy (2015-2035) and period plans gave high priority on increasing agriculture production and productivity and for this quality seed

is a vital component. Still there is limited interventions for quality seed production through precision and protected farming but many youth entrepreneurs and private companies are attracted towards this.

Conclusion and Way Forward

In Nepal the number of hybrid vegetable varieties imported over the years are huge compared to other crops as the seed replacement rate (SRR) for the vegetable is almost more than 90%. The research and development activities at a global level as well as some experiences from Nepalese conditions clearly justify the importance of precision and protected seed production in Nepal. Through the adoption of such practices, we can produce quality vegetable seeds for domestic demands as well as export markets.

The federal government i.e. Ministry of Agriculture and Livestock Development, is responsible for the policy support and quality control, likewise, the provincial ministry is mandated for provincial-level policy and program execution along with quality control, and the local level government is responsible for the local level program support based on the current practices.

Though this paper is based on the review and most of the discussion have been done based on the available information from the Indian context which can be replicated in the Nepalese context. To promote this technology, the respective tiers of governments should develop a plan based on the suggested way:

Tiers of government	Responsible organizations	Roles/responsibility
Federal Agriculture Development	Ministry/SQCC and Department of Agriculture	Formulating policies/acts/ guidelines for the promotion and support activities and market intelligence
Federal Agriculture Research	Horticulture Research Division and Provincial research units	Crop and zone specific research on vegetable seed production Development and maintenance of parental lines Development and maintenance of breeder seeds
Provincial Government	Provincial ministries/directorates/ knowledge centers/agriculture development offices/ farm centers	Technology dissemination Farmers support program Market information and networking
Local Government	Agriculture section	Technology extension Farmers support program Market information management

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