Technology Development in Vegetable Crop Sector in Nepal

S.L. Shrestha[1], I.P. Gautam[1] and T.P. Gotame[2]

[1] Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal

[2] Regional Agriculture Research Station, Parwanipur, Bara

Corresponding email: shsurendra@hotmail.com

Abstract

Production and productivity of vegetable crop is increasing in Nepal due to increased in area coverage, improved technology adoption and input availability. Sustainable vegetable cultivation by small farmers has been converting to semi-commercial to commercial farming especially in the vicinity of major cities and high way corridor. The main objective of this paper is to document available technology on vegetable in Nepal and make aware to the farmers, technicians and other stakeholders and insist for adoption. Improved technology developed by Nepal Agricultural Research Council, traditional good practices, and available good cultivation technology has been reviewed and documented in this paper. Available technology; registered and released open pollinated and hybrid vegetable varieties, plastic house technology, post-harvest technology, insect pest and disease management technology, enhancing vegetable gardening model, seed production technology, lead and collaborative station for breeder and foundation seed production and vegetable crops research has been summarized. Review showed that lack of location specific improved varieties is one of the major constraints of vegetable cultivation. Tomato, cabbage, cauliflower, bitter gourd, cucumber, brinjal, beans, radish and zucchini are the major vegetable crops where research works are being conducted. Total 38 open pollinated (OP) varieties released and 299 hybrid varieties registered in vegetable crops till 2018. Three hybrid tomato lines and one hybrid cucumber line developed by Horticulture Research Division are found to be promising and pipeline varieties. Beside this, two hybrid bitter gourd varieties, and one hybrid zucchini variety received from Seed Company has been recently registered and two OP variety each in french bean and asparagus bean, four hybrid varieties each in cabbage and cauliflower, and two hybrid in tomato proposal has been submitted for registration in Seed Quality Control Committee through variety release committee.

Keywords: *OP and hybrid varieties, registration, technology*

1. Introduction

Vegetable production is one of the most important aspects and is widely consumed in Nepal. Fresh vegetables play very important role in nutrition and food security, income generation and livelihood

improvement. Increased production and productivity of vegetables depends on high quality seed including hybrids (Pandey and Shakya, 2016). For increasing the production and the quality of the vegetables, several research programs have been carried out such as in varietal development/ breeding, disease and pest management, package of practice, breeder and foundation seed production, organic production technology and post-harvest management as well. According to the Central Bureau of Statistics, Ministry of Agriculture and Cooperatives (MoAC, 2010), there are a total of 55 vegetable crops being cultivated in Nepal where vegetable crops are cultivated in only 7.3 percent of the total cultivable land in Nepal. Total worth of vegetables (excluding potatoes) produced during 2009/10 was around Rs 105 billion, which is 8.8 percent of the country's AGDP. Per capita vegetable consumption has increased to 105 kg from 60 kg over last two decades due to increased in production area. Statistics showed that in the year of 2000/01 the production was 1500000 mt in an area of 100000 ha whereas it was gradually increased in the following years and in 2017, the production was 3800000 mt in an area of 250000 ha (VDD, 2017). Despite gradual increment in area coverage and productivity of vegetable crops, situation of vegetable seems in better position than that of fruits. Import substitution by vegetable crops has increased drastically and also export is started in small quantities. Even though positive signals of development of vegetable sector in Nepal, there are plenty of rooms for its development in the country through technological advancement.

Vegetable research and development is an important component of Nepalese Agriculture contributing significantly to nutrition, food security, economy and livelihoods of the people. Vegetable crops in Nepal have great potential for creating employment, income generation, food and nutrition security of the people and environment protection. Recently, the sector has appeared to be the main contributor of Nepal's agricultural GDP. The contribution of vegetable farming to the national economy is over 19 percent of the agricultural GDP whereas contribution of vegetables on GDP in 2016/17 is 5% (MoAD, 2017). The climatic diversity of Nepal is boon for successful cultivation of wide range of vegetable crops that require specific ecological conditions for commercial cultivation. Ever increasing demand of vegetables for import substitution and export promotion shows the potential of the sector. Considering the importance of the sector Nepal Agricultural Research Council (NARC) established Horticulture Research Division in 1994. Since its inception under NARC, HRD has been involved on developing technologies to meet the needs of clients. Despite critically insufficient infrastructure and human resources the division has been striving to generate the demand driven technologies with multi-stakeholders' participation and has been giving significant contribution on technology generation of vegetables.

The demand of fresh and processed vegetable products is also escalating because of rapid urbanization, changing food habit and consumers' awareness. Export is limited to few vegetable crops while list of imported vegetables are numerous and ever increasing. Technological superiority of giant neighbors over Nepal on all aspects of production value chain is one of the major challenges for us to compete in domestic and international markets. In this context, despite meager infrastructures available, with its goal to contribute science based vegetable research is moving forward to develop demand based technologies on vegetable crops. However, due to limitation of limited infrastructures and human resources the division is compelled to limit its activities on few selected commodities out of more than 50 economically important horticultural commodities. This time HRD is focusing its research activities on few selected vegetables focusing on following activities at present:

- Variety improvement of tomato and cucumber through conventional and hybrid breeding.
- Open pollinated cauliflower variety development for earliness and better taste.
- Broad leaf mustard varietal development for late bolters, better cooking quality, high yield, pest tolerance and year round production technology.
- Identification of better varieties of turnip, radish, okra, chilli, brinjal and asparagus bean to be able to be competitive with foreign seeds.
- Source seed management of vegetable crops through national networking.
- Off-season production of chayote

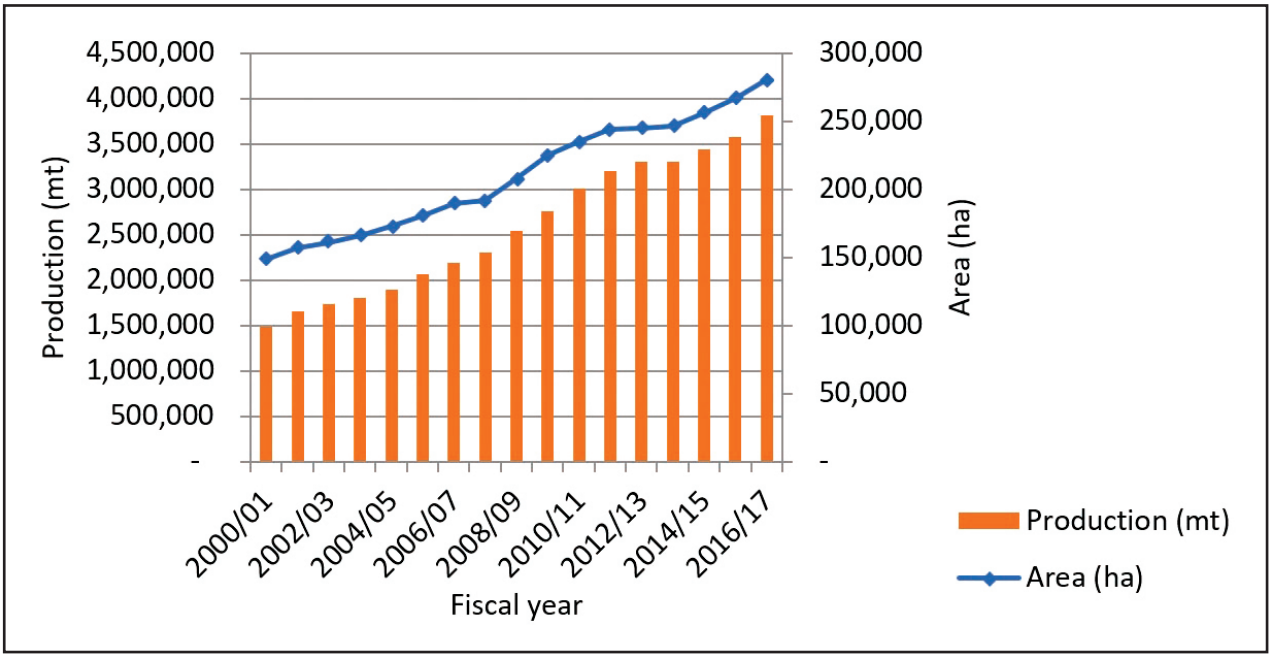

Figure 1: Area and production of vegetable crops during 2000/01 to 2016/17

Source: (VDD, 2016)

2. Materials and Methods

The HRD annual report published (2013/14, 2014/15, 2015/16, 2016/17) by NARC were being reviewed. Research programs are carried out under NARC in various research stations which are situating in different agro-ecological zones i.e. Temperate zone: Horticulture Research Station, Rajikot Jumla and Agriculture Research Station (ARS) Jaunbari, Ilam, where as for Sub temperate zone: RARS, Lumle, Kaski and ARS, Pakhribas, Sub-tropical zone: HRD, Khumaltar Lalitpur, HRS Dailekh, HRS, Malepatan, Ginger Research Programme, Salyan and National Citrus Research Programme, Dhankuta. Likewise, for tropical zone : RARS Nepalgunj, RARS Parwanipur, RARS, Tarahara and ARS, Belachapi and ARS, Surkhet. Basically, the research approaches were carried out in three phases i.e. on-station research, on-farm research and collaborative contract research.

On-station research: On the basis of village level planning, research program are formulated and conducted at regional agriculture research station (RARS) and agriculture research stations (ARS). More emphasis is given to research program based on farmers need and generate technologies acceptable to farming situation.

On-farm research: This research is conducted on farmers' field to verify the technologies released from on-station research. The field activities on farmers' field are conducted with joint efforts of farmers, researchers and extension workers, which promote horizontal linkages.

Research problem is developed from identified farmers' problems, implemented, and evaluated jointly and outstanding results are disseminated. This process provides researchable problems to be incorporated in both on-station and on-farm agenda thereby creating a downstream and upstream feedback mechanism, creating vertical linkages. RARS does the coordinating work among farmers, researchers, and extension workers.

Collaborative contract research: This type of research is conducted by signing MoU with the international organizations and agencies, international agriculture research centers and universities, and national organizations.

As many vegetables are grown in the country and lack of man power for research, RARS and ARS where vegetable research are done, have been assigned as lead and collaborative station as mentioned in Table 1.

Table 1. Multilocation trials in vegetable crops throughout the country (ARS and RARS)

Commodity	HRD, Khumaltar	ARS, Pakhribas	RARS Tarahara	ARS, Belachapi	RARS, Parwani	HRS, Malepatan	RARS, Lumle	GRP, Kapurkot	RARS Nepalgunj	ARS, Surkhet	HRS, Dailekh	RARS Doti	HRS, Rajikot
Capsicum	Lead	Colla			Colla			Colla	Colla		Colla		
Bean pole	Colla	Colla			Colla		Lead		Colla	Colla	Colla		
Brinjal			Colla		Lead	Colla			Colla				
Pea		Colla						Colla			Lead		Colla
Chilli	Lead	Colla	Colla		Colla				Colla		Colla	Colla	
Akabare Chilli	Colla	Lead				Colla					Colla		
Asparagus Bean pole bean		Colla		Colla		Lead			Colla		Colla		
Bush Bean		Colla				Lead			Colla	Colla	Colla		
Okra			Lead		Colla				Colla	Colla			
Determinate cowpea				Colla		Lead			Colla	Colla	Colla		
Lablab bean			Colla		Colla	Lead			Colla	Colla			
Faba bean	Lead	Colla		Colla		Colla					Colla	Colla	
Garlic (Bhote Type)				Colla		Colla		Colla					Lead
Garlic	Colla					Lead		Colla					Colla
Tomato	Lead	Colla	Colla		Colla		Colla		Colla	Colla		Colla	Colla
Radish	Lead	Colla	Colla						Colla		Colla	Colla	
Broad Leaf Mustard	Lead	Colla	Colla		Colla				Colla			Colla	
Cucumber	Lead												
Chayote	Lead		Colla		Colla								

3. Technologies Developed in Vegetable Sector

Technologies developed and available in current years have been categorized in varietal improvement, seed production, cultivation practices, insect pest and disease management, organic technology and post-harvest technologies which has been summarized here.

I. Varietal Improvement

Khumal Jyapu of cauliflower (25-30 t/ha), Kathmandu Red (30.60 t/ha) of turnip, Bhaktapur Local (25 t/ha) of cucumber were released in 2015 (FY2071/72).

Khumal Jyapu cauliflower was selected from Kathmandu Local (KTM) cauliflower population and has taste like Kathmandu Local, less attack by pest and disease, early maturing, harvestable 65-80 days after transplanting, become ready to harvest in Kartik (Dashain & Tihar festival) and is a good income source for mid-hills cauliflower farmers.

Kathmandu Red turnip was released in 2016, was selected from local red gante turnip population has red skin, white flesh color, flattish round shape, average root weight 225 gm, Days to first harvest: 55 days after sowing, upright plant growth and

Bhaktapur Local cucumber was released in 2018, has red skin, white flesh color, has Attractive color and & better taste, multiple branching habit, fruits: elongated, 26-30 cm long & 5-7 cm in diameter, predominant fruit skin color: white, male: female ratio- 11:1, recommended for mid-hills (600 to 1600 masl).

Thimi Chamsur (400 kg green leaf/ropani) of cress and Patane-palungo (830 kg green leaf/ropani) of Spinach were registered in 2017. *Thimi chamsur* is a local cultivar of garden cress, has dark green Leaf with pinkish white flower, plant harvestable 45-50 days after seed sowing, could be grown all round the year and recommended for Terai to high hills (<1000 to 7000 ft) and have seed yield 30 kg/ropani in seed production plot.

Patane-palungo is a local cultivar of spinach, has dark green Leaf with purple color on stem of leaf, plant harvestable 50-55days after seed sowing, grown Aswin to Poush in Terai and Bhadra to Margh in mid-hills and recommended for Terai to high hills (<1000 to 7000 ft) and have seed yield 35 kg/ropani in seed production plot.

Super Squash Ball Hybrid (30 t/ha) for hills, 2 hybrid variety for Terai i.e. CG 01(18-22 t/ha) and CG 02 (15-19 t/ha) of Bitter Gourd were registered recently in 2018. Super Squash Ball zucchini has round shape, light green, average fruit weight: 800-850 gm, days to mature after transplanting : 40-45 days, is recommended for mid hills with irrigation facility.

CG-01 bitter gourd has Medium spiny on fruit and slight tapering in ends, dark green color fruit, harvestable from seeding : 80-99 days, average fruit weight : 307.5 gm, fruit length : 25.6 cm, fruit diameter : 4.8-5.1 cm, Fruit shape : stout at the center and tapering towards both ends, Mild bitter in taste, tolerant to rainy season is recommended for eastern terai of Nepal.

CG-02 bitter gourd has white color fruit, harvestable from seeding : 80-99 days, average fruit weight : 302 gm, fruit length : 25-26 cm, fruit diameter : 4.7-4.8 cm, fruit shape : increase size at the center and tapering towards both ends, mild bitter in taste, tolerant to rainy season is recommended for eastern terai of Nepal.

HRA-14 x HRD-7, HRA-20 x HRD-1 and HRA-20 x HRD-2 are three promising lines of tomato which have higher yield and field resistance to diseases in Khumaltar condition. Tomato hybrid lines; 13X7, 14X7, 20X2 and 20X6 have shown superior performance at Tarahara and Parwanipur. In radish, HRDRAD-002 and HRDRAD005 showed superior performance in Khumaltar.

Two pole bean varieties: Semi light long (30-33 t/ha) and Long green bean (26-28 t/ha), and two asparagus bean varieties; Great wall-02 (20-25 t/ha) and Great wall-03 (25-30 t/ha) has been proposed for registration and going to be registered very soon.

Semi light long has light green pod, days to harvest from seeding: 70-75 DAS, pod length : 15-20 cm, Days to 50% flowering: 55-58 DAS, Pod length :15-20 cm, number of pods per cluster : 4.5, Number of pods per plant : 110-115 is recommended for mid-hills condition.

Long green bean has green pod, days to harvest from seeding: 75-78 DAS, pod length : 20-22 cm, Days to 50% flowering: 58-62 DAS, Pod length :15-20 cm, number of pods per cluster : 4.5, Number of pods per plant : 80-85 is recommended for mid-hills condition.

Great wall 02 asparagus bean has light green pod, pod length : 65-75 cm, number of pods per plant :46 is recommended for mid-hills condition. *Great wall* 03 asparagus bean has green pod, pod length : 70-80 cm, number of pods per plant :46 with least rust and virus disease is recommended for mid-hills condition.

Four cultivars (F1 hybrid) of Cabbage; Wonder Ball (70-75 t/ha) and Green challenger (50-60 t/ha) for hills and Shaurya (60-67 t/ha) and Millenium-111 (65-70t/ha) for Terai were submitted proposal for registration process.

Wonder ball cabbage has days to head initiation : 56 days, days to harvest from transplanting : 90-100 days, average head weight :1622 gram, average head length : 38 cm and width 39.7 is recommended for mid-hills condition.

Green challenger cabbage has days to head initiation : 55 days, days to harvest from transplanting : 90-100 days, Average head weight :1387 gram, Average head length : 33.9 cm and width 33.7 is recommended for mid-hills condition.

Shaurya cabbage has days to head initiation : 56-62 days, days to harvest from transplanting : 86-97 days, Average head weight :1306 gram, Average head length : 18 cm and width 17 is recommended for terai condition.

Millenium 111 cabbage has days to head initiation : 51-60 days, days to harvest from transplanting : 87 days, Average head weight :1400-1450 gram, Average head length : 13-18 cm and width 12-17 is recommended for terai condition.

Four cultivars (F1 hybrid) of Cauliflower i.e. Barkha (34-39 t/ha) and Girija (34-39 t/ha) for hills and Whistler (30-40 t/ha) for Terai were submitted proposal for registration.

Barkha cauliflower has days to curd initiation : 33 days, days to harvest from transplanting : 60-65 days, Average curd weight :1039 gram, Average plant length : 51 cm and width 38 cm is recommended for mid-hills condition.

Girija cauliflower has days to curd initiation : 53 days, days to harvest from transplanting : 85-90 days, Average curd weight :1259 gram, Average plant length : 46 cm and width 37 cm is recommended for mid-hills condition.

Whistler cauliflower has days to curd initiation : 57-63 days, days to harvest from transplanting : 77-80 days, Average curd weight :1307 gram, Average curd length : 18 cm and width 19 cm is recommended for terai condition.

Two cultivars (F1 hybrid) of tomato ; Aviral (83 t/ha) and Abhilash (79 t/ha) for terai were submitted proposal for registration.

Aviral tomato has days to flowering from transplanting : 35 days, Average fruit weight :59 gram, Average fruit length : 4.2 cm and width 5.2 cm with round fruit shape is recommended for terai condition.

Abhilash tomato has days to flowering from transplanting : 32 days, Average fruit weight :72 gram, Average fruit length : 4.6 cm and width 5.6 cm with flat round fruit shape is recommended for terai condition.

II. Seed Production

NARC has the mandate of breeder seed production of vegetable crops. According to the crop and variety, NARC station has been assigned on the base of agro-ecological zone and its potentiality. HRD has been producing breeders seed of broad leaf mustard cvs.. Khumal Chadapat and Khumal Rato Pat, radish cvs.Mino-Early, Fourty Days and Pyuthane Red, pole bean cvs. Trisuli and Four Season bean, Asparagus bean cv. Khumal Tane, Cauliflower cvs. Khumal Jyapu, Jyapu, Kathmandu Local, cucumber cvs. Bhaktapur Local, Turnip sv. Kathmandu Red and parental lines of Srijana hybrid tomato

Srijana hybrid tomato which was developed and registered by HRD in 2010 has been maintaining its parental lines and producing Srijana hybrid seed every year under private partnership program (PPP). HRD has MoU with twelve private organizations including NGOs, for Srijana hybrid seed production and producing around 60-70 kg seed annually under the supervision of HRD (Table 2). Likewise, the governmental organizations such as Central Vegetable Seed Production, Lalitpur; Horticulture Research Station, Dailekh; Sub-temperate Vegetable Seed Production, Rukum and Horticulture Research Station, Malepatan are also involved in this activity.

Table 2. List of parental line received for Srijana hybrid seed production by private sector and stations through HRD Khumaltar and production

S.N.	Name of organization	Production (kg)
	N-Agro concern, Lalitpur	2071/72 : 69 kg 2072/73 : 67 kg 2073/74 : 63 kg 2074/75 : 80 kg
	Kathmandu Agro Concern, Lalitpur	
	NEMACOL, Kalimati	
	CEAPRED, Lalitpur	
	Agro Shala Nepal, Lagankhel	
	Shrestha Seed Pvt. Ltd. Bhaktapur	
	Himalayan Seeds Research &Training Center, Dolakha	
	Puspanjali Seed Production Group, Lalitpur	
	Pramila Krishi Farm, Kathmandu	
	CGNS Pvt. Ltd. Kalanki	
	SEAN, Thankot	

Govt. Organization		
	Central Vegetable Seed Production, Lalitpur	
	Horticulture Research Station, Dailekh	
	Sub-temperate Vegetable Seed Production, Rukum	
	Horticulture Research Station, Malepatan	

III. Cultivation Practices

Polyhouse technology has been used for tomato production in different locations which thus proved to be very successful and at present it is widely used for rainy season production. Various design according to the altitude and various models are available.

IV. Insect Pest and Disease Management

Insect pest and diseases are the major problem in vegetable production. Insect pest and disease infection use to start even from nursery beds and the success of the vegetable farming depends upon the health status of nursery seedlings also. Using mosquito net for healthy seedlings in nursery bed is a easy technique for saving from insect pest and disease infection.

Potato Leaf Minor (PLM) damage in potato crop is recorded in Kathmandu (82%), Bhaaktapur (71%), Lalitpur (89%), Kavrepalanchok (49%) Makawanpur (10%) and Sindhupalchok (14%). It is advised to adopt integrated crop management techniques for managing PLM; by spraying Abomictin 1.5 ml/L and use moveable yellow flex sticky with greese (2-4 m long x 20-100 cm width) (Prabidhi Sangalo 4).

Potato tuber moth is an insect pest of potato in the storage and sometime may attack in the field also. It could be managed by integrated approaches; use clean seed, 10 cm depth planting, save tuber from exposing if the field with irrigation and earthing up, cleaning of store before storage, deep infested tubers in water for 24 hrs and dry under shade store. It could be done pre storage treatment; Mix Bojho powder 2 gm/kg tuber, mix tubers with shaded dried artemisia or mint @ 300-330 gm/crate, mix 5 g Malathian powder per kg seed tuber, and mix 5-6 g granulo virus or BT per kg tuber.

South American Leaf Minor (Tuta absoluta) is new emerging insect pest especially for tomato during dry period. If timely not controlled, it may damage tomato crop within one week. It could be controlled by using Light trap, electric mosquito bat, tracer (Spinosad) or Coragen @ 1ml/3L, and collect infested leaf with larvae and destroy.

Shoot and fruit borer of Brinjal is a major insect of brinjal crop where it enters in the shoot and also fruit and shoot tip starts wilting and whole appears on the fruits. It can be controlled by adopting Integrated management approaches; prepare healthy nursery seedlings inside the net, deep nursery seedlings in spinocide soluting (0.3 ml/L) and transplant, Collect infested shoot and fruit and destroy, using Lucin-lure pheromone at 10 m interval, spraying BT kursataki @ 2g/L, spraying Spinosad 45 SC @ 0.3 ml/L or Nimbicidin 2ml/L or Coragen 3 ml/L for the control of shoot and fruit borer of Brinjal.

Red Ant in potato become problem near about the forest area during bulking and dry period. It can be managed by; using Chloropyriphos or Darsban 10% granule 1kg/ropani, growing carrot as trap crop, using Asuro, Khiro etc as green manuring, mix Banmara, Titepati, Ketuki cut leaf @250-300

kg/ropani in land preparation, drenching with neem based Azodiractin @5 ml/L : 100 ml/plant, drenching with 1:5 (cow urine: water) + tobacco powder 5 gm/L : 100 ml/plant, use bait dipped in Chloropyriphos 20% EC or Darsban 20% EC @1.5 ml/L.

Late Blight in Potato may loss 100 percent crop and yield loss if not managed timely. However, it could be managed by integrated approaches ; enough earthing up to save from infection, halm pulling, grow LB resistant varieties: LBR40, PRP 25861.1, PRP 266264.01, CIP 384321.15, crop rotation with cereal crops, spraying of sectin or acrobat 1.5 g/L and Mancozeb 2.5 g/L.

Club root of crucifer is a fungus affecting cauliflower, cabbage, broad leaf mustrd, radish, cress etc, which can be managed by intensive approaches; using mustard cake and agri-lime on soil, crop rotation, nursery soil solarization, use of older seedling (7 wks), seedling treatment with Benlate for 15-20 mins before transplanting and use of pesticides T-spiadole (Bio-control) and Nebijin (chemical).

Root Knot Nematode in tomato is emerging as a problem in tunnel cultivation. It can be managed by grafting tomato with wild brinjal (*Solanum sissimbrifolium*) in plastic house.

V. Organic Technology

EM Bokashi preparation technique has been standardized & verified. Milled rice husk 100 kg, bone meal 10 kg, oil cake 10 kg, EM 150 ml, gur 10 g and water 35 liters. Mixed EM and gur in water and stored for 24 hours. Mixed the liquid in the above mentioned materials, cover the heap by polythene and stored in shade for 20 days and applied while preparing the land. It contents 3.21 %N, 5.20 P and 2.5% K.

Liquid fertilizer (Jhol mal) preparation technique has been developed & recommended. It is a fermented liquid fertilizer using locally available biological materials. The mixture keeps in the airtight plastic drum till 1-2 months in dark and cool place. Reduction of gas production (reduced foam) indicates ready to use. This preparation contains 0.50% N, 0.25% P and 0.60% K. It is diluted 1:4 ratios in water and applied as soil drench or sprayed on plant at fortnightly intervals. It repels sucking small insects from plants.

School vegetable gardening technology developed, recommended & disseminated. It has developed school garden design, curriculum & school gardening package, and selected vegetables for school garden (according to the school calendar). Now, Ministry of Education has promoted this technology and some schools has adopted also.

VI. Available Post-harvest Technologies

Use of zeolite for vegetable seed storage is a new emerging technology where, zeolite beats are used for drying vegetable seeds and absorbing moisture in the storage container. Beats are 10000 times re-useable and absorbs only moisture without any reaction. Beats are dried in oven at 250ºC for 2-2.5 hrs.

Some technologies on harvesting index, harvesting time, method, grading standards and packaging materials identified for hot pepper and tomato. Various types of post-harvest handling technologies are available:

Solar dryer is suitable for drying fruits and vegetables in remote and inaccessible area. It has various models available and GO and NGOs promoting the technology in remote districts.

Rustic stores is suitable for storage of potato seed.

Zero-energy cool chamber is a natural cool container prepared by locally available materials and used for storing fresh vegetables and fruits for short term storage.

Pot-in-pot store is a small cool container prepared by two different size mud pots generally for fresh carrot and others vegetable storage for domestic purpose.

Cellar store is used for citrus and apple storage.

4. Way Forward

- Infrastructure (disease diagnostic laboratory, storage system for breeder seeds and planting materials, post harvest study labs, green house and net house structures, irrigation systems for fields) should be strengthened.
- Necessary strategic reforms and supports to strengthen research capability to address priority demand driven issues and options, developing necessary policies, and marketing supports, and enhancing collaboration linkage with stake holders for efficient and effective outputs delivery should be improved to address new challenges and opportunity.
- National vegetable research program envisaged by APP to be established at Khumaltar ha not yet come to reality.
- Vegetable is an important, but only one component of horticulture. It is obvious that output is primarily depends on the inputs. The allocated budget for vegetable research is quite low on the basis of its contribution in AGDP.
- In the wake of Nepal's development effort in vegetable research, the concept of the international and regional network linkages has been realized as the most effective means.
- Now a days there has been a tremendous progress in the field of breeding, biotechnology, production and post-harvest management in vegetable crops, in other parts of the world and even in our neighboring countries. Nepal should take the advantages of those R and D through the exchange of scientists/experts, expert visits, the exchange of germplasm and planting materials.
- The present level of staff positions, their deployment and disciplinary expertise are not sufficient enough to be responsive for the technological demands. Furthermore, the current number and their ecological coverage of NARC research stations are not representative for research under taking and validations. To make vegetable research more effective and efficient in a coordinated manner, advancement of the division to a level of National Horticulture Research Institute with divisions like vegetables, fruits, flowers, medicinal & herbal, post-harvest horticulture and horticultural technologies information centre (HTIC) should be established.

References

APP. 1995. Agriculture Perspective Plan, 1995-2014, Ministry of Agricultural Development, Singh Durbar, Kathmandu, Nepal

Giri, Y.P., D. Bhattarai, B.K. Joshi, P. Paneru, T. Paudel, A. Rayamajhi, and B. Sapkota. 2073. Krishi Prabidhi Sangraha-4. Nepal Agriculture Research Council, Singhdurbar plaza, Kathmandu, Nepal

Giri, Y.P., D. Bhattarai, S.K. Wagle, R.P. Ghimire and B.B. Pokhrel. 2074. Krishi Prabidhi Sangraha-5. Nepal Agriculture Research Council, Singhdurbar plaza, Kathmandu, Nepal

HRD. 2014. Annual Report 2070/71 (2013/14). Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal.

HRD. 2016. Annual Report 2071/72 (2014/15). Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal.

HRD. 2016. Annual Report 2072/73 (2015/16). Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal.

HRD. 2017. Annual Report 2073/74 (2016/17). Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal.

HRD. 2018. Annual Report 2074/75 (2017/18). Horticulture Research Division, NARC, Khumaltar, Lalitpur, Nepal.

MoAD. 2016. Statistical information on Nepalese agriculture, Ministry of Agricultural Development; Agri-Business Promotion and Statistics Division, Singh Durbar Kathmandu, Nepal

Pandey, I.R. and S.M. Shakya. 2016. Vegetbale development in the last six decades in Nepal. In: Six Decades of Horticulture Development. Nepal Horticulture Society. Pp. 54-82.

Paudyal, K.P. and P.P. Khatiwada. 2013. Current status of resource allocation for horticultural research under Nepal Agriculture Research Council. In: Proceedings of the eight national horticulture seminar on horticulture development towards the pace of national economic growth, Kathmandu, Nepal, Pp. 83-91.

Pradhan, N.G., G.D. Subedi, P. Adhikary, D.R. Bhattarai, I.P. Gautam, R.D. Timila, C. Manandhar, R.C. Gauli, S. Shrestha. 2074. Prangarik Tarkari Kheti Prabidhi. Horticulture Research Division, Nepal Agriculture Research Council. Khumaltar, Lalitpur, Nepal.

VDD. 2016. Annual progress report, Vegetable Development Directorate (VDD), Agriculture Department, Ministry of Agricultural Development, Khumaltra Lalitpur, Nepal