Vegetable Production Techniques for Livelihood security for Small and Marginal Farmers: A Review

Abstract

The aim of this study was to determine the major factors influencing farmer's decision to adopt the released and recommended varieties and technologies developed by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli. At present, farmers are encountering problems of low yield, pest and diseases and declining productivity due to continuous cultivation. The most important factors influencing the adoption of improved varieties were high yield, resistant to biotic and abiotic stresses and high market demand with more shelf life. In addition, resistance to pest and diseases incidence, early maturing characteristics and suitable for rice based cropping system were identified as adoption factors. Farmers who adopt the production techniques of university increased their income levels and consequently were able to provide for their needs such as housing, to purchase farm tools and equipments and transport vehicles, to expand their farm operations, to educate their children and to provide appropriate health care. Social benefits included employment, enhanced local business.

Keywords: Vegetables, Crop improvement, Crop and nutrient management, plant protection, small and marginal farmers, livelihood security, Konkan region.

Introduction

The present article portrays the landscape of vegetable production techniques in Konkan region of Maharashtra. The cardinal cultivation of agriculture in South Konkan circumvent around Mango and Cashew cultivation while that of North Konkan relies on Rice cultivation. But vegetable cultivation in both agro eco zones has proved to be buffer economic base during critical period of main crops due to minimal requirement of temporal and spatial aspects farmers can reap the benefits in shorter cultivation period. Around 11,000 ha area is under vegetable cultivation in Konkan. Though varieties of vegetable crops are cultivated in Konkan their optimum yield potential under varying climatic condition is not yet exploited. Heavy precipitation during monsoon diffused light intensities in cloudy climate supposed to be factors influencing the yield and pest-disease resistance. Thus it is call of the day under volatile climatic conditions to probe of genotype having qualitative and quantitative upper age to sustain under extreme biotic and abiotic stress conditions. This will facilitate to search for genotypes with efficient translocation and partitioning of photosynthates without any apparent losses in metabolic events. Thus the review paper will furnish the insights for inferring the genes involved for various morphological, physiological and biochemical attributes in various vegetable crops. The anology and the synthesis of various findings of review shall help to prepare the road map for vegetable crop improvement in Konkan region of Maharashtra.

The aim of this study was to review the research work done in Vegetable Crops at different locations of the university and to extend the awareness of scientific cultivation of vegetables towards the farmers, and to determine the major influencing farmers decision to adopt the different technologies recommended by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for Maharashtra State particularly for Konkan region. The area under vegetable crops is 13,097 ha, 5.95 lakh ha and 95.42 lakh ha in Konkan, Maharashtra and India respectively. India ranks 2nd only after China in production of vegetables, producing 2.01 lakh tones), 87.83 lakh tones and 169.54 lakh respectively [17,18]. The productivity of the vegetables in Konkan is as equal as the productivity of state of national level. The Konkan

region is divided in two cropping system viz. Rice based cropping system in North Konkan and Horticultural based cropping system in South Konkan. As far as vegetable production is concerned maximum area is occupied in north konkan region, particularly Palghar, Thane and Raigad districts. As the yield potential is as good as to state level and national level there is a tremendous potential for vegetable cultivation in both the region. Though there is good potential for Vegetable production the area under vegetable is very less which can be increased by utilizing the residual moisture of kharif seasons for the short durational important vegetables. The climatic conditions are very suitable for growing of vegetables during *Kharif* (for Cucurbits and Okra) during *Rabi* (for Solanaceous, Leguminous and Cruciferous crops) and on small scale during *Summer* due to scarcity of water. There is also good scope for production of these vegetables for domestic requirement as well as near by urban area/city markets like Pune, Mumbai and Kolhapur.

Though India ranks 2nd in vegetable production there is a big gap in per capita demand and supply as per the standard levels (per capita consumption of vegetable is only around 150 g as against a minimum of about 300g). The major reason behind it is post harvest losses (30-40%) which are 20 times more than developed countries [60]. However, now a days the vegetable scenario is rapidly changing due to major shift in consumption pattern of fresh and processed vegetables. Most vegetables are rich source of vitamins, minerals, proteins, carbohydrate etc. which are essential for human nutrition. Hence these are referred as a protective food and assumed great importance as a nutritional security of the people.

The recent emphasis is on vegetable research due to need for attaining nutrition security and for more profitable land use. Growing of vegetable assumes greater importance in context of shrinking land, depleting water availability because vegetable have lesser demand on water and other inputs besides being 3 to 4 times less than that of field crops. Most of the vegetables are seasonal or biennual requiring only three to four months to complete their life cycle and also can be cultivable on waste land which can supply the fresh vegetable almost round the year and are highly economical particularly for marginal and small farmers, which are also tolerant to moisture stress [60]. Vegetable cultivation generates the labour employment opportunities and contributes to higher rural income. As compared to other crops, most of the vegetables are very less sensitive to the climate change and can be survive and tolerate in adverse/unfavourble climatic conditions. Vegetables play important role in emerging economics scenario due to existence of tremendous potential for export of fresh, processed and exotic vegetable. So there is tremendous scope for post harvest handling and management (Organized marketing) and value addition of vegetables particularly for perishable commodities.

Improvement in quality and quantity standards of the vegetable produce and their marketing are essential to increases India's share in global market. With the opening of global market, research and development in vegetable have received impressive support in last 15 years. As a result vegetable production technologies were developed and find tunned for adoption to stake holders technologies such as varieties, land races integrated nutrient management (INM), integrated water management (IWM), integrated pest management (IPM), protected cultivation etc. were developed to improve quantitative and qualitative standards of the vegetables. The improvement in such technologies has effectively supported the breeders in crop improvement programmes through application of selection criteria and that will increases the probabilities of varieties being adopted by large number of farmers.

Thus the underlying purpose of study is to review & determine the major factors influencing farmer's decisions as to the technologies to adopt. However the specific objective of this study is to review the various technologies in vegetable crops.

Crop Improvement- Varieties Released

Tomato (Sonali)

In Konkan region wilt sick soils are the major constraints in cultivation of Tomato particularly for bacterial wilt disease. Accordingly the efforts were made and eleven types of tomatoes had been evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, the type Sel-2 (Sonali) with average fruit yield (490 q/ha) which was significantly superior over rest of the types. The variety Sonali was also found resistant to the Bacterial wilt. The variety is also moderately resistant to fruit borer. The fruits are oblong and attractive red in colour. It has good keeping quality and good transport capacity. It has determinate growth habit and the variety released for Konkan region of Maharashtra for cultivation in *Rabi* season [3].

Chilli (Konkan Kirti)

By considering the need of Chilli in konkan region screening for yield and disease resistance has been done for nine different chilli genotypes at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, the variety DPL-1 (Konkan Kirti) with average green fruit yield- 11.50 q/ha which was significant over rest of the genotypes. The fruits are medium long (8.22 cm) with average weight 3.5 g. The fruits are dark green in colour with medium pungency. The growth habit is bushy with 310 fruits/plant. The variety showed moderately resistance to the leaf curt disease. It has good keeping quality & found suitable for green and dry chillies. The variety Konkan Kirti was released for cultivation in *Rabi* season for Konkan region. The development of this improved variety augmented the chilli cultivation along the west coast of Maharashtra [4].

Dolichos Bean (Konkan Bhushan)

Leguminous crops have tremendous scope in coastal region of konkan. There was consumers demand to have good bean type especially for vegetable purpose. So the study was undertaken and evaluated four types of Dolichos Bean at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, the type DPL-D-1 (Konkan Bhushan) recorded average pod yield 12 t/ha which was significantly superior over the remaining 3 types. The pods are attractive, green in colour with pod length (5-10cm). The growth habit dwarf bushy with early bearing produces 15-17 pods/plant having good keeping quality. The variety konkan Bhushan is released for cultivation in *Rabi* season for Konkan region. The release of variety augmented the Dolichos bean area in Konkan region of Maharashtra [5].

Snake Gourd (Konkan Shweta)

Snake gourd has good preference in local markets of konkan. To study the production and quality parameters in Snake gourd, six types of were evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, the type DPL-SG-1 (Konkan Shweta) recorded average fruit yield (25/ha) which was significantly superior over other varieties. It has a 100-115 cm long fruits with 250-280 average fruit weight. The fruits are white in colour with good keeping quality. The variety belongs to early maturity group. The variety Konkan Shweta was released for cultivation in *Kharif* season and also this improved variety enhances the area under this crop Konkan region [6].

Ridge Gourd (Konkan Harita)

To find out good yield potential with quality and disease resistance traits of Ridge gourd eight different types were evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Among them, DPL RG-1 (Konkan Harita) recorded maximum fruit yield (17.04 t/ha) which was significantly superior over the other types tested. The fruits of variety Konkan Harita are dark green in colour with soft ridges and belonging to medium long group with 40-45 cm. The average fruit weight is 168 gm. The variety is early growing with good shelf life (5 - 6 days) and good transport capacity. The variety also shows moderate tolerant to Downy

mildew. This improved variety increases the area under Ridge Gourd and released for cultivation in *Kharif* Season for Konkan region [7].

Bitter Gourd

Konkan Tara

To have the sustainable type of Bitter gourd in high rainfall along with good yield and quality characters, ten different types of Bitter gourd were evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Type DPLBG-2 (Konkan Tara) with potential fruit yield 13.0 t/ha which was superior over other types tested. The fruits of this variety are dark green with prickly surface. The fruits are medium long & tapering towards both ends belongs to early maturity group. The fruits are having good keeping quality with thick rind. The variety is moderately resistance to Downy Mildew and Anthracnose. The variety Konkan Tara is released for cultivation in *Kharif* and *Summer* season for Konkan region. The development of this improved variety augmented the Bitter Gourd area along the west coast of Maharashtra [8].

Konkan Karli

In Bitter gourd, the previous released variety Konkan Tara was with medium in length and tapering towards both ends. By considering the consumers preference and demand for long type the experiment was conducted at Vegetable Improvement Scheme, Central Experiment Station, Wakawali and released the long type variety Konkan Karli with 20-25 cm long fruits, Number of fruits **(6 - 7),** Av. Fruit weight (106.40 g) and yield 16-18 t/ha. The variety is also suitable and sustainable to the high rainfall area of Konkan region [20].

Cucumber

Sheetal

Considering the acceptability to green colour Cucumber type along with good yield potential and sustainable to high rains, eight different types of cucumber were screened for Disease pest reaction, yield and quality parameters at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Out of which, the type DPL-1 (Sheetal) recorded maximum fruit yield 36.36 t/ha which was significantly superior over rest of the types. The fruits are oblong, medium green in colour with average weight 200-250 gm. The variety belongs to early maturity group and it is suitable for high rainfall area. The fruits have good keeping quality. The variety also found tolerant to Downey mildew disease. The variety Sheetal is released for cultivation in *Kharif* season for Konkan region and rest of Maharashtra. The released variety has satisfactory area under cultivation in Konkan region of Maharashtra [9].

Konkan Kakdi

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli has already released the variety Sheetal with light green colour fruits but there was a demand of farmers to have a variety with a greenish white fruits with high yield and suitable for high rainfall. So evaluated four types along with existing check Sheetal and released the variety Konkan Kakdi with the yield of 26 – 28 t/ha, fruit weight (200-220 g) and Number of fruits / vine (9 - 10) [21].

Drumstick (Konkan Ruchira)

To develop medium long Drumstick type with good pulp and taste and sustainable to heavy rainfall of the konkan region the study was undertaken at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. After evaluating the 41 types of drumstick, released the variety Konkan Ruchira (DPL-DS-15) which recorded maximum pod yield (36.63 kg /plant) among different The pods are dark green in colour, long triangular in shape and with good tasty pulp. The variety is moderately resistant to stem canker. The release of variety enhanced the area under this crop in Konkan [10].

Yard Long Bean (Konkan Wali)

Yard long bean **(**Wali**)** is very famous for its long green pods for vegetable purpose in konkan as well as Goa State. To find out suitable type for Konkan region, screening of different 22 types of was done for quality and yield attributes at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Among them, the type DPL VS- 20 (Konkan Wali) recorded the highest green pod yield 9.5 t/ha which was significantly superior over the other types and recorded 59.46% increase over local check. The pods are light green in colour, smooth with 30-35 cm long. The variety is early with good keeping quality. The variety can be grown with minimum support. It was moderately resistance to Mosaic and Rust disease. The variety Konkan Wali is released for cultivation in *Rabi* season and also augmented the area under this crop in Konkan region [11].

Amaranthus (Konkan Durangi)

To reap the maximum yield of leafy vegetable Amaranthus and to find suitable type for Konkan agro climatic conditions the study was done and twenty two different types of amaranthus were evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Among tested types, the type DPL-AM-2 recorded the highest leaf yield of 22.60 t/ha which was significantly superior over other types. The leaves of Konkan Durangi are broad with prominent venation. Upper surface of leaves is attractive green with red tinge towards petiole, while lower surface is reddish. Petiole and stem colour is also attractive red. It has low branching habit with late bolting character. The variety is having erect growth habit, early maturity with good keeping quality. Konkan Durangi has good taste, fibreless, good consistency and colour after cooking. The variety is free from serious pest & diseases. The variety Konkan Durangi is released for cultivation in *Rabi* & *Summer* season for Konkan region. The release of this variety enhances the area under this crop in coastal region of Maharashtra [12].

Coriander (Konkan Kasturi):-

Coriander is very famous for its aroma which is a part an parcel of daily diet due to its use in culinary purpose. By considering its importance and need in the region, six different types were evaluated for yield and quality parameters at Vegetable Improvement Scheme, Central Experiment Station, Wakawali Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, among tested types, DPL COR-1 (Konkan Kasturi) recorded maximum herbage yield 106.42 t/ha which was significantly superior over the other tested types. The leaves are broad, attractive dark green with reddish tinged petiole. The variety is having good aroma (Aldehyde Mandrine). The variety is early maturing with spreading type growth habit, good shelf life and free from diseases and pests. The variety Konkan Kasturi is released for cultivation in *Rabi* - *Summer* season for Konkan region [15].

Snap Melon (Konkan Madhur)

Snapmelon is very popular cucurbit crop grown for table purpose as a vegetable and mainly as a religious purpose particularly in Ganesh festival and Durga puja in the konkan region. By considering all these facts and with the object of evolving high yielding, good flavour and less cracking type in Snapmelon, eight types were evaluated at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The genotype, DPL SM-2 (Konkan Madhur) recorded maximum fruit yield 15.31 t/ha which was significantly superior over the rest of the types. The fruit is having globular shape with yellowish to dark brown spots with light green ridges. It has less cracking percentage (9 %) with firm pulp of light orange colour. The variety has good keeping quality (3-4 days), tolerant to Downey mildew, moisture stress and can also survived in heavy rains. The variety Konkan Madhur was released for cultivation in *Kharif* and *Summer* season for Konkan region [16].

Sponge Gourd (Konkan Ghosali)

To enhance the production and to find out suitable type of sponge gourd for the Konkan agroclimatic conditions, the evaluation of two cross combinations with recommended check Pusa Chikni was done and released the variety Konkan Ghosali by pedigree selection method with yield **(**18-20 t/ha**)**, fruits/ vine **(**10-11**)** and fruit weight **(**110-120g**)**. The variety is also suitable for high rainfall [22].

Crop Management -

Yard long bean: Training - Recommendation

The farmers are cultivating yard long bean by using traditional methods of training (forest twigs) as there is no any suitable and recommended method of training. As Wali exhibit the viny growth, farmers use forest twigs for training which is laborious and time consuming and not feasible for commercial cultivation. Hence for commercial cultivation of wali on large scale, a proper training system with less laborious work and least input cost was needed to optimise the yield. Therefore, the experiment was conducted with seven different training methods. Among different training methods, the crop trained on plastic rope supported by three horizontally fixed GI wires (0.6 m+1 m+2 m) from ground was found to be economically superior for getting maximum yield (13.19 t/ha). Hence above said training method was recommended for Wali during *Rabi* season [19].

Brinjal : Arka Nidhi - Recommendation

Brinjal is being cultivated by farmers in Konkan region during *Rabi* season. They are growing brinjal using local types which are low yielding and indiscriminate. These local types are also susceptible to Bacterial wilt disease. In view of this, fourteen different brinjal genotypes were tested to find out high yielding and bacterial wilt disease resistant type suitable for this region. Among the different types tested, Arka Nidhi variety was found to be having high yield (273.90 q/ha) and also resistant to bacterial wilt disease. Hence Arka Nidhi variety is recommended for cultivation during *Rabi* season [13].

Chilli : Utkal Ragini – Recommendation

The farmers are growing the chilli crop with local types which are low yielding, less pungent with faint red colour. In view of this 23 different genotypes of chilli were tested to find out high yielding and especially red colour chilli suitable for konkan region. However university has released well known variety Konkan Kirti which is less pungent and having faint red colour along with high pungency and yield. Hence Utkal Ragini is recommended for cultivation in Konkan region during Rabi season [15].

Tomato : LE - 66 – Recommendation

Low yielding as well as wilt susceptible local types of tomato is being grown by the farmers in Konkan region. For this purpose, eighteen different genotypes of Tomato were tested to find out high yielding and resistance to Bacterial wilt type suitable for Konkan region. Among the different types tested, LE – 66 variety was found to be having high yielding (236.34 q/ha) and also resistant to bacterial wilt disease. Hence LE - 66 variety is recommended for cultivation during *Rabi* season [14].

As far as training methods are concerned cucurbits responds well to training methods. Bitter gourd (Konkan Tara) variety has been evaluated in terms yield where Kniffin and Bower system suited well and economically feasible for getting maximum yield (78.25 q/ha) [32].

Growth regulators play vital role for vegetable crops by manipulating physiological activities to attain higher yield. Among those NAA (25 ppm), Triacontanol (2 ppm) and GA_3 (100 ppm) were found to be better alternatives for boosting up the yield of Okra (Varsha Uphar variety) i.e. 38.93 q/ha [76]**,** while Triacontanol (4 ppm) found to be thebest for better yield in chilli var. Konkan Kirti (12.42 t/ha) [49].

Standardization of different propagation techniques in Drumstick by using growth regulators viz. IAA, NAA, IBA, Cytokinin, GA and 2, 4–D was done. Among the treatments of growth regulators studied NAA @ 2500 ppm showed maximum sprouting of cutting (80

%) as well as rooting and survival of cutting (73 %). Considering ease for propagation and relative cost of chemicals, NAA @ 2500 ppm was found best proposition for vegetative propagation of Drumstick under coastal condition of Maharashtra [40].

In context with mulching, black polythene mulch followed by paddy straw mulching gave maximum green ginger yield in of Ginger (*Zingiber officinale* R.) i.e. 32.67 t/ha and 32.40 t/ha respectively [62].

After evaluation of twenty one different Okra genotypes for growth and yield parameters to find out high yielding type suitable for Konkan region. Among the different types screened, JNDOL-03-1 genotype was found to be having high yield (112.73 q/ha) and earlier type [31].

After screening for growth and yield parameters of nineteen chilli genotypes, Pant C-3 type recorded maximum fruit yield 19.72 t/ha followed by the LCA-334 (19.61 t/ha), while highest number of fruits per plant were observed in the variety Konkan Kirti (173) and found suitable for cultivation during Rabi season in Konkan region of Maharashtra [101].

Nutrient Management

Nutrient management is the only solution to maintain soil fertility and agro environment even by intensive farming. Besides inorganic fertilizers as the major components, other sources includes farmyard manure (FYM), composts, green manure, crop residues, crop rotation and bio-fertilizers. Konkan region of Maharahstra is spread with the variability like climate, soil and crop. In general the Konkan region is known for lateritic soil but some area is covered with medium black soil and Coastal saline soil. Vegetables crops grown in Konkan region are Yard Long Bean, Zucchini, Drumstick, Brinjal, Watermelon, Tomato, Dolichous Bean, Coriander, Bitter gourd, Spinach beet, Cucumber, Onion, Okra, Chilli and other vegetables. Work done in Konkan region regarding vegetable crop is reviewed in this article.

Chilli

Effect of different starters was found to be significantly influenced on survived growth, flowering, fruiting and quality of chilli (*Capsicum annum* L.). The starters in solution help to give the better survival, growth, fruit set, yield and quality of chilli fruits over their corresponding solid application and the controls. Treatment T_3 (Starter No. 2 containing Urea + Single Super Phosphate + Muriate of Potash in 2:1:1 proportion in liquid form) proved over all superiority in improving the growth, yield and quality of chilli variety DPL C –1 [73]. However the effect of super digested forest litter compost for nutrient uptake and yield of Chilli in lateritic soil of Konkan [97]. The results indicated that application of Phosphorous @ 50 kg P_2O_5 ha^{-1} and 5 @ 30 kg ha along with 150 kg N and 50 kg K_2O ha^{-1} were adequate in boosting the yield of Chilli without any noticeable detrimental effect on soil. Super digested litter compost of shivan @ 15 t ha^{-1}& Super digested litter compost of Karanj @ 15 t ha^{-1} with 50% NPK recommended or 50% NK recommended were found to be the best treatments in increasing the nutrients uptake and pod yield of Chilli as well as improving the soil physical & chemical properties of soil. Moreover, the significant effect of Phosphorous and Sulphur on yield and uptake of nutrients of chilli and adequate in boosting with the application of P @ 50 kg P_2O_5 ha^{-1} and S @30 kg ha^{-1} along with 150 kg N and 50 kg K_2O ha^{-1}than other treatments [54]. The application of Urea Godavari-briquettes (3 briquettes per plant) first at urea splitting, second at 30 DAT and third at 60 DAT was found to be significantly superior over rest of all the treatments of yield and recorded higher plant height and number of pods per plant. The quality of the pods in terms of ascorbic acid & capsaicin content increased with application of organic manures alone. He noticed that the available nutrient status (N, P & K) in soil after harvest was found to be improved due to application of all three types of briquettes as composed to RDF & RDN based on soil test [59]. Further, from the study of effect of different growth regulators and micronutrient complex on growth and yield of chilli (*Capsicum annum* L.) var. Konkan Kirti it was found that the foliar sprays of growth regulators like 2 ppm triaconazole or 25 ppm NAA given at

vegetative stage (2 sprays,) flowering (1 spray) and fruiting (2 sprays) resulted in highest vegetative growth, early flowering, fruiting and highest yield. The fertilizer combination of recommended dose of micronutrient complex was the promising treatment which provided vegetative growth as well as yield. Exclusive application of micronutrient complex retarded the plant vegetative growth, yield and fruit characters. An integrated application of recommended dose (NPK @ 150:50:50 kg/ha) along with micronutrient complex (ORMICHEM @ 75kg/ha) and foliar sprays of 2 ppm triacontanol or 25 ppm NAA is economical and feasible techniques for fetching highest remuneration in chilli [56].

Okra

Impact of bio-organic soil enriched (Celrich) had been recorded significant effect on growth attributes, yield of Okra and physico-chemical properties in lateritic soils of Konkan. The application of celrich @ 2t + recommended dose of fertilizers were found to be maximum fruit and seed yield than other [95]. Also integration of organic manure and inorganic fertilizers showed significant effect on soil fertility, growth, yield of Okra, nutrient uptake in lateritic soil. Balanced application of nutrients viz; N, P_2O_5& K_2O at the highest level i.e, 150 +75+75 kg/ha respectively through chemical fertilizer is very much effective for achieving high productivity of Okra. Though, the combined application of FYM @ 7.5 t/ha and balanced nutrient application @ 150 kg N+75 kg P_2O_5 +75 kg K_2O ha^{-1} together gave the highest productivity (85.01 q/ha) Okra than other applications [94]. However, integrated use of fertilizers i.e. receiving 75% N of RD (recommended dose) + gromore bio-ferilizer @ 2t/ha the 100% NPK through chemical fertilizers showed significantly increased in growth, fruit and stover yield of Okra. In addition to the application of bio-fertilizer @ 2t /ha along with 75% N of RD improve quality of Okra fruit and higher uptake of major nutrient like N, P, K, Ca, Mg and also their availability of soil enhanced with combining use of bio-fertilizer and nitrogen through chemical fertilizers. While, the fruits yield and dry stalk yield of Okra were recorded highest with integrated use of fertilizers. Amongst all the treatments, the application of 75% N through inorganic fertilizers + FYM @ 7.5 t ha^{-1} + BI showed significantly highest yield and nutrient content of Okra [61,85]. The integrated use of fertilizers, manures and bio-fertilizers enhanced uptake of all major nutrient and micro nutrients (Zn, B) and also quality of Okra (i.e. crude protein, crude fat, carbohydrate, ascorbic acid & ash contain). Among all treatments the RDF + $ZnSO_4$ (25 kg) + Borax (5 kg ha^{-1}) + FYM (10Kg ha) + Azospirilium (5 kg ha^{-1}) shows superiority than other applications. Application of effluent concentration @ 25, 50, 75 & 100 per cent along with 100, 75, 50 & 25 per cent RDF with FYM & vermi-compost had been recorded significantly higher in respect to build up of soil fertility, growth, yield of okra and uptake of all macro & micro nutrient [68]. It was observed that from an experiment which was conducted on nutrient management with relation to its growth, yield, nutrient uptake and changes in nutrient availability on Okra in Lateritic soil of Konkan region, amongst the manure i.e, FYM and vermin-compost application of FYM @ 7.5 ton ha-1 to Okra crop during *Kharif* season in lateritic soil was observed more effective for enhancing the percent of protein [36].

Onion

Conjoint use of inorganic fertilizers and organic manuring had been recorded that the significant effect on growth attributes, dry matter yield, bulb yield, nutrient content, nutrient uptake and quality of onions. The application of NPK @ 150:75:75 kg/ha along with FYM @ 20 t/ha was noticed higher bulb yield & improved quality of onion [91].

Cucumber

Significant and efficient use of nutrients by the effect of varying levels of irrigation and nitrogenous on growth, yield and quality of cucumber were observed. The irrigation at 25 cm CPE (at 4-5 days interval) and fertilization with a dose of 150 kg N/ha were noticed higher yield and quality of cucumber in lateritic soil of Konkan. The irrigation schedule involved in irrigations and consumptive water use was 433.83 ha^{-1} mm [74]. Similarly, efficacy of Konkan Annapurna Briquettes (KAB) with different coating materials were recorded

higher yield and quality of cucumber. The tar coated Konkan Annapurna briquette promising to enhancing the yield contributing and Bio chemical properties like ascorbic acid [93]. Moreover, the cucumber F_1 hybrid Padmini followed by Malini was found most suitable for growth, Physical parameter, and yield and yield attributing character. The hybrid Malini was found superior for fruit traits. While the yield/vine (kg) and Yield/ha (t) the hybrid Padmini was found superior. NPK had positive effect on growth and yield of cucumber as it enhanced cucumber production. Among Different level of NPK, F_3 (250:100:50 NPK kg/ha) was found to be optimum dose for maximization of yield of cucumber per ha under Konkan agro-climatic condition. By taking into consideration above these two factors, F1 hybrid Padmini showed better performance under Konkan agro-climatic condition while fertilizer level F_3 (250:100:50 NPK kg/ha) noticed the highest fruit yield per hectare [80].

Bitter Gourd

Integrated nutrient supply system had been recorded significant effect on soil fertility, yield and nutrient uptake of Bitter Gourd. The higher yield and growth were recorded with combination of PSB + Azotobacter seed treatment, whereas uptake of N, P, K, Ca and their nutrients availability with conjunctive use of biofertilizers and nitrogen through chemical fertilizers [2].

Spinach Beet

The application of effluent before sowing with inorganic fertilizers or application of effluent before sowing and after first cutting with inorganic fertilizers were noticed significantly increased the growth parameters like plant height, number of leaves per plant, yield of Spinach beet, nutrient content, uptake and higher monetary return with good B:C ratio over only NPK. Application of effluent before sowing with 100% RDF was found to be useful for enhancing the spinach production with increased profit [102].

Coriander

On the basis of herbage yield and seed yield, coriander cultivar (Konkan Kasturi) was evaluated against different fertilizer doses, where fertilizer doses of 120:30:30 and 80:40:40 (N:P:K) kg/ha was found to higher in terms of herbage yield (117.72 q/ha) and seed yield (13.95 q/ha). Hence, for getting more herbage yield of coriander var. Konkan Kasturi by the application of 100:30:30 NPK kg/ha than other treatments. Similarly, increased levels of nitrogen, phosphorus and potassium significantly affected the seed yield also. The high seed yield with 13.98 q ha^{-1} was recorded in T_5 receiving 120:30:30 NPK kg ha^{-1}) which was closely followed by T_4 receiving (100:30:30 NPK kg ha^{-1}) with 13.97 q ha^{-1} and with T_3 receiving 80:30:30 NPK kg ha^{-1} and seed yield of 13.95 q ha^{-1}. Hence, with regards to seed yield a fertilizer dose of 80:40:40 NPK kg/ha should be given for getting more seed yield of Konkan Kasturi [48].

Dolichos Bean

Nitrogen levels of, three levels of Phosphorus and two growth regulators (Vipul and NAA) shown promising effect on yield of DPL-D-1 cultivar (Dolichos Spp.) and the Vipul granules per ha have not shown promising effect. The cost of Vipul granules per kg is more as compare to nitrogen and phosphorus which is not economical. The dose of 50 kg N ha^{-1} and 50 kg P ha^{-1} showed more economical than other treatments[39]. Similarly, the performance of different fertilizer briquettes on Dolichos bean (*Dolichos lablab L*) to yield, nutrient uptake and soil properties in lateritic soils, concluded that the application of UB 10-26-26 briquettes, one briquette in between two plants were found to be promising enhance the green pod yield of Dolichos bean in lateritic soils of Konkan. The application of nutrients in the form of UB-10-26-26 briquettes can reduce the recommended dose of NPK fertilizer to the extent of 50 % [88].

Tomato

The study was conducted on different levels of fertilizers and spacing on the growth and yield performance of tomato, the application of 200 kg N ha^{-1} along with 50 kg $P_2O_5ha^{-1}$ by following closer spacing of 60 x 40 cm for better growth and yield of tomato. Moreover,

Irrigation at 30 mm CPE and fertilizer dose of 150:75:75 kg NPK per ha are recommended for tomato [38].

Watermelon

The combination of 75 kg N ha^{-1}, 30 kg P_2O_5 $ha^{-1}$and 75 kg K_2O ha^{-1} had been recorded better yield and the quality of fruit, whereas at higher level of phosphate for getting optimum requirement of N, P and K for Sugar Baby [52]. The fertilizer dose of 20 t FYM, 250: 50: 100 kg/ha on growth and yield of hybrid Watermelon showed better performance in yield t/ha (30.45), No. of fruits/vine 3.19 [23]. Effect of different levels of fertilizer on growth and yield of F_1 hybrids of watermelon (*Citrullus lanatus thunb.*) under Konkan agro-climatic condition, the F_1 hybrid V4 (Vigro 286) showed better performance in yield characters viz., fruit yield per vine, fruit yield per plot, fruit yield per hectare, fruit weight and chemical parameters viz., total sugars and reducing sugars [1]. The hybrid V_4 also recorded significantly highest average fruit weight (3.75 kg) over all other hybrids. Further, it was also observed that the same hybrid recorded the highest fruit yield of 5.97 kg/vine, 119.39 kg/plot and 59.9 kg/ha and also was found to be significantly superior over rest of the hybrids. However, the soil application of potassium and foliar spray of zinc and boron on yield and quality of Watermelon [*Citrullus lanatus (Thunb.)*] had recorded significant effect. The application of 75 kg K_2O ha^{-1} through soil along with 0.5% Zn and 0.1% B through foliar application were noticed effective to increase the yield of watermelon and maintain the quality of fruits and helps to sustain the nutrient content in soils [50].

Yard Long Bean

The farmers of Konkan region are cultivating yard long bean by adopting local package of practices. There was no any recommendation with regards to nutrient management in yard long bean for optimizing yield. So in order to standardize the fertilizer dose in wali the experiment was conducted for three years with four different fertilizer doses. Among those fertilizer dose of N: P: K, dose of 150:60:30 kg/ha along with 20 tons of FYM recorded the maximum pod yield (13.75 t/ha) during three years. Hence aforesaid dose is recommended for cultivation of wali during *Rabi* season [19]. However spacing and fertilizers applications were found to be significant effect on growth, yield and quality of yard long bean (Konkan Wali) grown under Konkan agro-climatic conditions. The medium spacing (75 X 120 cm) with 60:60:45 kg NPK/ha fertilizer was recorded for maximization of green pod yield of Konkan Wali [34].

Zucchini

Effect of spacing and fertilizer levels were found to be significantly influence in growth and yield of Zucchini (KORA-F1). Better vegetative growth, yield and yield contributing characters along with physical parameters, Zucchini should be planted at spacing of 60 × 60 cm with application of fertilizer dose 150:50:50 kg NPK/ha along with compost @ 15 t/ha [68].

Brinjal

The maximum height was observed in N_3 = 150 kg ha^{-1} and P_2 = 100 kg, treatment and least height in N_1= 50 kg $ha^{-1}$and P_0 = 0 kg ha^{-1} treatment. N_3 = 150 kg $ha^{-1}$and P_2 = 100 kg ha^{-1} produced more no of flowers and fruits of better quality than N_1= 50 kg $ha^{-1}$and P0 = 0 kg ha^{-1}. The ascorbic acid, moisture and crude protein was also found higher in N_3 = 150 kg $ha^{-1}$and P_2 = 100 kg $ha^{-1}$and least N_1= 50 kg ha^{-1} and P0 = 0 kg ha^{-1}. It is seen that 150 kg N ha^{-1} and 50 kg ha^{-1}significantly produced maximum yield of Brinjal. Hence, it is recommended to fertilize variety Bandhtivare with 150 kg N $ha^{-1}$and 50 kg P ha^{-1} [63]. Moreover, effect of planting density of organic and inorganic fertilizers and their interaction of export quality, the treatments comprised different combination of organic and inorganic fertilizers, F.Y.M, Neemcake, Celrich and Vikas were used exclusively and in combination with half recommended dose i.e. 50:25:12 NPK kg/ha and full recommended dose was used as central. The integration use of fertilizers and manures showed significant effect on pods yield and qualitative aspects but the shelf life of pods didn't show any effect [97]. Similar

results were observed with the application of N120 + RIA in Palak var All Green and N120 + NAA in Kangkong can be rated as best package for high yield. This package facilitated rapid growth, more yield, more no of leaves, leaf area, leaf thickness, which ensure better photosynthetic activities [66].

Drumstick

Application of fertilizer 150:75:75g NPK/plant/year proved to be optimum with reference to all growth, yield and quality parameters. It is also important that application of excess dose of fertilizer (200:125:125 g NPK/plant/hear) is determinate for growth, yield and quality of drumstick. Among different chemicals tried, triaconazole was found superior closely followed by Biozyme (10ppm) and GA3 (20ppm) whereas pruning at height 50 cm performed excellently. It short, it can be recommended that drumstick should be fertilized with a dose of 150:75:75 g NPK/planting coupled with foliar sprays (5 times) of trianconazole (5 ppm) or Biozyme (10ppm) or GA3 (20ppm) and pruning the plant at 50 cm height which proved to be the best package [98].

Irrigation water management:

Dolichos Bean:

The effect of irrigation schedules and mulch on yield of dolichos bean under micro sprinkler irrigation in lateritic soils of Konkan and found that irrigation at 80% of PE by micro sprinkler with grass mulch gave maximum green pod yield (99.66 q/ha) which was significantly superior over irrigation at 25mm CPE (66.13q/ha). Maximum water use efficiency (241.67 kg/ha.cm) was observed in treatment irrigation at 60% of PE by micro sprinkler irrigation. The per cent saving of water by various treatments over control was in the range of 50 to 70%. The highest net returns of Rs.45088/- was obtained in treatment irrigation at 80% of PE by micro sprinkler + grass mulch with benefit: cost ratio of 1.61 [89].

Bitter gourd:

While studying the effect of subsurface irrigation and irrigation schedules on yield of bitter gourd the treatment subsurface irrigation with diffuser and grass mulch recorded significantly superior fruit yield (85.16 q/ha) over rest of the treatments. The treatment irrigation at 100% of PE registered significantly higher fruit yield (107.44 q/ha) and was at par with irrigation at 80% of PE. Maximum water use efficiency (532.43 kg/ha.cm) was observed in treatment combination irrigation at 80% of PE + subsurface irrigation with diffuser and grass mulch. Subsurface irrigation with diffuser and grass mulch + irrigation at 100% of PE gave the highest net returns of Rs. 30757/- ha with benefit: cost ratio 1.38 [90].

Chilli:

The effect of micro irrigation methods and fertilizer levels on growth and yield of chilli as well as the micro sprinkler irrigation at 100% PE + 100% RDF (150:50:50 NPK) recorded maximum green chilli yield of 118.23q/ha as compared to all other treatments. The effect of irrigation level was found to be significant and maximum yield (132.32 q/ha) was recorded in the treatment irrigation at 100% of PE, whereas minimum yield (90.06q/ha) was recorded in the treatment irrigation at 60% of PE. The water use efficiency arranged between 62kg/ha.cm to 272kg/ha.cm. Higher water use efficiency (272kg/ha.cm) was found with micro sprinkler at 100% PE with recommended dose of fertilizer. The B:C ratio was 3.06 in micro sprinkler at 100% PE + 100% RDF [25].

Cabbage

To increase the water use efficiency in Cabbage the field experiment was conducted during the year 2005-2007 at Central Experiment Station, Wakawali. The effect of irrigation regimes coupled with organic and inorganic fertilizers and the yield of cabbage (Cv. Golden acre) and the micro sprinkler and found that the treatment 80% of PE recorded higher cabbage yield (142.97q/ha) as compared to rest of the treatments. The treatment RDF (120:60:60kg:N:P:K/ha) registered significantly higher yield of cabbage (146.05q/ha) over

the remaining treatments the increase is yield of cabbage due to the treatment RDF was to the tune of 65% and 12% as compared to 100% N through FYM and 100% N through poultry manual. Also maximum water use efficiency was recorded in treatment combination irrigation at 40% of PE by micro sprinkler + RDF and the maximum B:C ratio (1.37) was obtained in treatment combination irrigation at 80% of PE by micro sprinkler + RDF [92].

Brinjal

To study the effect of irrigation and fertigation levels on the yield and nutrient uptake of Brinjal under drip irrigation the field experiment was conducted during the year 2009-2010 at Agronomy farm Dapoli and found that the treatment 100% RDF through water soluble fertilizer recorded significantly superior yield (36.74 t/ha) over 80% RDF through water soluble fertilizer (32.31 t/ha) the total nutrient uptake of nitrogen (144.4kg/ha), phosphorus (44.13kg/ha) and potassium (203.6 kg/ha) was noted to be significantly higher under the fertigation level 100% RDF through water soluble fertilizer. The maximum fertilizer use efficiency of NPK was 71.81, 62.52 and 153.7% respectively under the treatment 80% RDF through water soluble fertilizer [96].

Plant protection:

Insect pest management

Crop	Pest	Sub-heading	Details
Brinjal	**Shoot and fruit borer, *Leucinodesorbonalis*(Lepidoptera., Pyralidae)**	**Management**	The insecticides *viz*; fenvalerate @ 0.01 per cent, Emamectin benzoate @ 0.0033 per cent, polytrin @ 0.066 per cent, carbaryl 0.1 per cent, spinosad 0.035 per cent and novaluron 0.0075 per cent were found effective in reducing the fruit damage. The highest (27966.67 kg/ha) marketable fruit yield was recorded in the treatment Emamectin benzoate @ 0.0033 per cent [27,42,64,79].
	Pest complex	**Management**	Black plastic mulch followed by silver plastic mulch recorded less population of sucking pests[81].
Chilli	**Fruit borer *Helicoverpaarmigera*(Lepidoptera; Noctuidae)**	**Management**	The laboratory experiment conducted to study the efficacy of insecticides revealed that Emametin benzoate @ 0.002 per cent recorded 36.67 per cent mortality and it was at par with spinosad @ 0.14 per cent with 30 per cent mortality after 24 hr treatment [26].
	Thrips	**Management**	The treatment spray of Azadirachtin 10000 ppm @ 3 ml/lit at 7 days interval alone recorded lowest thrips count (2.76 per leaf) which was at par with the treatments spray of 10 per cent cow urine and Azadirachtin 10000 ppm @ 3ml/lit at 7 days interval with thrip count 3.45 per leaf. The maximum 73.23 per cent reduction in thrips population over control was observed in treatment Azadirachtin 10000 ppm @ 3 ml/lit at 7 days interval followed by 66.81 per cent reduction in 10 percent cow urine alternate with Azadirachtin 10000 PPM @ 3ml/lit at 7 days interval [82].
	Pest complex	**Management**	Emamectin benzoate 5SG @0.001 per cent was most effective against thrips, whereas, lambda cyhalothrin 5EC @0.003 per cent was found effective against aphids and whiteflies [30].
Dolichous bean	**Pest Complex**	**Management**	The insecticidal treatments *viz;* 0.05 per cent DDVP + 0.1 per cent Carbaryl, 0.002 per cent emamectin benzoate, 0.006 per cent Cypermethrin + Profenophos were found effective against bean aphid, *Aphis craccivora*; hairy caterpillar, *E. icilia*; spotted pod borer, *Maruca vitrata* and leaf miner, *Liriomyza brassicae* [71]
Cucurbits	**Fruit fly**	**Management**	Deltamethrin @ 0.0025 per cent was effective in reducing fruit damage (20.15 %) and was at par with DDVP @0.05 percent (22 %), Emamectin benzoate @ 0.0016 per cent (24.00 %) and azadirachtin @ 0.0025 per cent (24.79 %). Further maximum fly population was in the traps charged with 3ml methyl eugenol+3ml cue lure (10333.33 flies), whereas least fruit flies were trapped in the traps charged with cue lure 3ml alone

			(378.33 fruit flies) and 1ml methyl eugenol +3ml cue lure (375.33 fruit flies) [78].
Melon	**Fruit fly**	**Management**	The cumulative mean per cent mortality of all the periods were revealed that cartap hydrochloride 50 SP @ 0.075 per cent emerged as a highly effective chemical for the management of leaf miner, *L. trifolii* among all the treatments with 53.26 per cent mortality and remained at par with azadirachtin 10000 ppm @ 0.003 per cent (45.67 %) and triazophos 40 EC @ 0.08 per cent (34.73 %) [44].
Fruit fly		**Management**	The cue lure 3ml and 2ml trapped maximum number of fruit flies during the course of investigation and cue lure was found to be the best treatment for trapping fruit flies infesting little gourd. The mixture of Methyl Eugenol 3ml + cue lure 3ml was the third best treatment but will be costlier as compared to cue lure. Hence it is recommended to use cue lure 3ml per trap for mass trapping of fruit flies infesting Little Gourd [37].
Okra	**Shoot and fruit borer (*Eariasvittella*)**	**Biochemical parameters**	The studies on relation of biochemical constituents with the infestation of *E. vittella* revealed that the parameters *viz.*, phenols, potassium and calcium were negatively correlated with the fruit infestation, whereas, reducing sugar, non-reducing sugar, total sugars, protein, phosphorous, nitrogen and magnesium were positively correlated with fruit infestation. This positive correlation was also significant except magnesium [86].
		Management	The studies of an insecticidal trial against Okra pests revealed that out of nine insecticidal treatment schedule tested, the insecticidal treatment schedule comprising of 0.035 per cent Ducord followed by 0.03 per cent Dimethoate and 0.5 per cent Neemazal (0.53 overall mean aphid population per 15 leaves/five plants) and an insecticidal treatment schedule with 0.07 per cent Polytrin-c followed by 0.005 per cent Imidacloprid, 0.5 per cent Neemazal and 0.03 per cent *Bt* (11.56 overall mean aphid population/15 leaves/five plants) were the most effective in controlling Okra aphids, *A. gossypii* [58.]
			The relative efficacy of different treatments after three sprays on number basis indicated that Endosulfan 0.06 per cent recorded less per cent fruit infestation (9.57%) followed by *Bacillus thuringiensis* var. *kurstaki* @ 1.5 g/L, *Beuveria bassiana* @ 5 g/L, Neemazal @ 4ml/L and NSKE 5 per cent which recorded 13.49, 15.28, 15.91 and 16.76 per cent fruit infestation, respectively and were at par with each other [35].
			The habitat manipulation studies indicated that the minimum per cent fruit infestation was recorded in sunflower (20.01) as a border crop followed by Marigold (21.86) and Sweet corn (22.98), while maximum infestation was noticed in check (33.61) with no border crop. Effect of IPM module on infestation of okra shoot and fruit borer indicated that the infestation ranging from 7.35 to 21.52 per cent in IPM and 20.53 to 27.16 in non-IPM plot during 18th December to 24th December 2014. While after 24th December,

			per cent fruit infestation was ranging from 3.08 to 10.00 in IPM and 15.35 to 40.80 in non-IPM plot. IPM plot recorded significantly minimum fruit infestation than non-IPM plot from 27th December to 21st January 2015[75].
			The overall results of field experiment after three sprayings revealed that the treatments *viz.,* Emamectin benzoate 5 SG @ 0.0017 per cent and spinosad 45 SC @ 0.014 were effective insecticides for the management of shoot and fruit borer of okra. The cumulative effect of all the spray indicated that Emamectin benzoate 5 SG @ 0.0017 per cent and spinosad 45 SC @ 0.014 per cent recorded less fruit infestation (23.47 and 29.78%, respectively) and were at par with each other. The other insecticides with descending order of effectiveness were Indoxacarb 14.5 SC @ 0.0096, Deltametrin 2.8 EC @ 0.0028, Lambda-cyhalothrin5 EC @ 0.00375, *Bacillus thuringiensis* var. *Kurstaki* Berliner @ 2 g-1 and Azadirachtin @ 0.003 per cent which recorded 31.78, 35.41, 38.42, 42.59 and 44.25 per cent fruit infestation, respectively. All the above treatments were found to be superior over untreated control which recorded maximum (54.84 %) fruit infestation [86].
	Pest complex	**Management**	The overall observations recorded on efficacy of nine insecticides against various pests like shoot and fruit borer, *E. vittella,* flea beetle, *P. bowringi;* leafhopper, *A. biguttula biguttul*, aphid, and whitefly, *B. tabici* infesting okra indicated that all insecticides under test were proved superior over untreated control in reducing incidence of all above pests and also giving increased yield of marketable fruits. The treatment with Deltamethrin 2.8 EC @ 12.5 g a.i./ha was found most promising and significantly superior over all other treatments with insecticides in reducing the infestation of fruit borer followed by Emamectin Benzoate 5 SG @ 8.5 g a. i./ha and Lambda-cyhalothrin 5 EC @ 40.0 g a.i./ha on number basis. The efficacy of insecticides judged on weight basis indicated more or less similar results. Above three insecticides were found to be equally effective in preventing damage by *E. vittella.* The results also showed that the Okra field treated with lambda-cyhalothrin 5 EC @ 40.0 g a. i. / ha recorded minimum mean per cent leaf damage due to *P. bowringi* followed by Deltamethrin 2.8 EC @ 12.5 g a.i./ha and Endosulfan 35 EC @ 350.0 g a. i. /ha [29].
	Whitefly	**Management**	Four sprays (2 spray of Acetamiprid 20 % SP @ 0.005 per cent and 2 spray of Diafenthiuron 50 % WP @ 0.05 per cent) at an interval of 15 DAS or silver mulching + two sprays of insecticides *i.e.* (Acetamiprid 20 % SP @ 0.005 per cent and Diafenthiuron 50 % WP @ 0.05 per cent) or Neem cake @ 10 t/ha + (50 % N + recommended P + double K.) + two sprays of insecticides *i.e.* (Acetamiprid 20 % SP @ 0.005 per cent and Diafenthiuron 50 % WP @ 0.05 per cent) may be given for effective

			management of whitefly [72].
Tomato	**Fruit borer *Helicoverpa armigera* (Hubner)**	**Management**	The treatment with combination of Abamectin 1.9 EC (0.0009 %) + azadirachtin 1500 ppm 2 ml/ lit was found most effective followed by *B. thuringenesis* 1 kg/ha + Abamectin 1.9 EC (0.009%), *B. bassiana* 1.25 kg/ha + Abamectin 1.9 EC (0.0009 %) and *V. leacanii* 2.5 kg/ha + Abamectin 1.9 EC (0.0009 %) which were at par with other [99].
	White fly	**Management**	The treatment with combination of *B. bassiana* 1.25 kg/ha + Abamectin 1.9 EC (0.0009 %) recorded least whitefly population and offered longer protection to the crop followed by *V. leacanii* 2.5 kg/ha + Abamectin 1.9 EC (0.0009 %). The treatment with combination of Abamectin 1.9 EC (0.0009 %) + Azadirachtin 1500 ppm 2 ml/lit and *B. thuringenesis* 1 kg/ha + Abamectin 1.9 EC (0.009 %) were ranked 3rd and 4th best treatment in order of merit, respectively [99].
	Leaf hopper	**Management**	Combined application of *V. leacanii* 2.5 kg/ha + Abamectin 1.9 EC (0.0009 %) was noticed most effective treatment in reducing the population of leafhopper followed by treatments with combination of *B. bassiana* 1.25 kg/ha + Abamectin 1.9 EC (0.0009 %), Abamectin 1.9 EC (0.0009 %) + Azadirachtin 1500 ppm 2ml/lit and *B. thuringenesis* 1kg/ha + abamectin 1.9 EC (0.009 %) which were at par with each other [99].
	Fruit borer *(Spodoptera Litura)*	**Management**	The treatment with combination of *Ha*NPV 0.5 l/ha + Abamectin 1.9 EC (0.0009 %) was found most effective treatment which recorded minimum infestation of fruit borer larvae followed by *Ha*NPV 0.5 l/ha + NSKE (5 %) + Karanj oil (1 %), *B. thuringenesis* 1 kg/ha + Abamectin 1.9EC (0.009%) and *B. bassiana* 1.25 kg/ha + abamectin 1.9 EC (0.0009 %) which were at par with each other. Data recorded on per cent fruit infestation by fruit borer and yield indicated that the treatment consisted of combination of *Ha*NPV 0.5 l/ha + Abamectin 1.9 EC (0.0009 %) was recorded least per cent fruit infestation (13.35%) and maximum yield (11.31 t/ha) followed by *Ha*NPV 0.5 l/ha + NSKE (5%) + Karanjoil (1%) (13.74 % and 11.17 t/ha) and *B. thuringenesis* 1 kg/ha + Abamectin 1.9 EC (0.009%) (14.04% and 11.02 t/ha) which were at par with each other [99].

Diseases:

Sr. No.	Crop	Name of disease	Management
1.	Dolichos bean	Yellow mosaic virus (YMV)	Crop sown on 10th of October compared to all other sowing dates the virus causing yellow mosaic of Dolichous bean in the field significantly reduced the grain yield per plant [77].
2.	Ridge Gourd	Downy mildew	Metalaxyl + Mancozeb (0.1%) was highly effective against downy mildew disease and yield of Ridge Gourd was more in fungicidal treated plots than in untreated control plots. The disease was mainly influenced by crop age, minimum air temperature & relative humidity [51]
3.	Tomato	Leaf curl	Maximum & minimum temperature and relative humidity had direct correlation with percent disease incidence [24]
4.	Brinjal	Wilt	Wilt Complex pathogens can be managed effectively with resistant varieties [28].
5.	Bitter Gourd	Anthracnose & root knot of nematode	Maximum reduction in disease over control was observed in treatment R.D.F. + thirum + glyricidia leaves + tilt (57.64%) [46]
6.	Okra	Powdery mildew	Early sowing of crop. Spraying with tridemorph was most effective with 67.05% disease control followed by spraying with Hexaconazole & wettable sulphur was recorded in plot treated with Adathoda vesica leaf extract [53].
		Alternaria leaf blight	Hexaconazole 0.1%, Mancozeb 0.2%, Carbendenzim 0.1% and COC 0.05% were effective in inhibiting growth of fungus causing leaf blight of Okra [65]
7.	Watermelon	Alternaria blight, Fusarium wilt and bud necrosis	Use of promising cultivars. Fungicidal & insecticidal spray after 45 DAS for better yield [41].
8.	Little Gourd	Leaf spot	Propiconazole (0.1%) & Benomyl (0.1%) equally inhibited 100% growth of test fungus. The bio agents like Trichoderma Sp. Inhibit the fungal growth. The bulb extract of Garlic 10% also inbilits mycelial growth of pathogen over control [45].
9.	Bottle Gourd	Wilt	Carbendenzim (0.1%) and C.O.C (0.2%) completely inhibited mycelial growth of fungus. The bio agents like Trichoderma & Aspergillus sp. were proved to be antagonistic. Among different plant extracts tested Sadafuli (41.66%) followed by Garlic (25.66) inhibited mycelial growth[47].
10.	Cabbage	Leaf spot	Difenconazole (0.1%) recorded maximum inhibition of fungus followed by Manconzeb. Mancozeb (0.25%) was most effective at field conditions followed by Azoxystrobin (0.1%) for control of disease. The varieties such as green voyager, Cabbage No. 139, Ankur Manas and cabbage No. 118. were resistant to disease [55].

Economic survey of production and marketing of different vegetable crops:

Cucumber:

The average size of holding of sample farmers was 0.70 ha with average operational holding of 1.58 ha. The cropping pattern of study area was dominated by Kharif crop (76.85%). The production at overall level was 54.65 q with productivity of 81.61 q per ha, while studding the economics of production and marketing of Cucumber in Pen tahsil of Raigad district of Maharashtra. As constraints in production and marketing of Cucumber, it was also observed that lack of market information was the major problem in study area faced by 80 % farmers. 77 % farmers had constraints of non remunerative price offered to their produce, while 72 % farmers stated for higher wages of labour [33].

Chilli:

While studding economics of production and marketing of Capsicum in Thane district (M.S.) and observed that average size of holding of sample farm was 10.96 ha. out of the gross cropped area (11.90 ha) the share of vegetable crops (54.97 %) highest and was dominated by *Rabi* crops and perennial crops. Overall Capsicum production was 201.45 MT and productivity was 63.34 M.T./ha. After studying the different marketing channels, the maximum (98.20 %) cultivators sold their produce through whole sellers cum- commission agents followed by village traders and retailers [69].

Pesticide use:

The variables area under vegetables (ha), expenditure on fertilizers (Rs.), expenditure on human labour (Rs.) and total family income (Rs.) were fond to be significantly contributing factors to the gross income while contribution of resistance externality to the gross income was negative, while studying the externalities in pesticide use in vegetables in Thane district of Maharashtra state. It was also observed that 35 % of farmers were not aware of prophylactic use and dose of plant protection chemicals and 29 % farmers were ignorant of the recommended doses [87].

Conclusion :

By considering the need of Konkan region of Maharashtra, the enhancement of better quality and sustainable productivity of vegetable crops through crop improvement programme (Development of new varieties) and recommendations for advance production technologies along with effective soil and water management practices have been proved more economical and adoptable for the farmers. As per the recommended nutrient management practices buildup of soil-plant quality and optimizing crop productivity by applying integration of organic and inorganic fertilizer management. In addition to severe deficiencies of macro and micro nutrient in to soil and plant also, farmer should apply recommended dose of fertilizers along with deficient macro and micro nutrient through soil and foliar applications. In case of pest and disease crop management, due to the devastating effect of insect pests and diseases of vegetable at almost every stage of its development, several approaches have been adopted in its control. Research on the control of these insect pests and diseases has centered primarily on the use of synthetic pesticides. The economic impact of pesticides control in vegetable production and further showed that with proper timing; insecticide and fungicide applications could produce good vegetable yield. This would be advantageous from the perspectives of lower costs and environmental pollution.

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