SABB Journal of Food and Agriculture Science Vol. 2(1), pp. 15-19, January, 2012
Available online at http://www.isabb.academicjournals.org/JFAS
DOI: 10.5897/ISAAB-JFAS11.029
ISSN 1937-3244 ©2012 Academic Journals

Full Length Research Paper

Response of vegetable crops to use of integrated nutrient management practices

Jag Paul Sharma[1], Puja Rattan[1]* and Sanjeev Kumar[2]

[1]Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu (SKUAST-J), Main Campus, Chatha, Jammu, J&K 180009, India.
[2]Division of Vegetable Science and Floriculture, Main Campus, Chatha, Jammu, J&K 180009, India.

Accepted 25 November, 2011

The investigation reports response of cucumber, knol khol, broccoli and radish to the use of integrated nutrient management practices at the experimental farm of the Division of Vegetable Science and Floriculture, FOA, Chatha, SKUAST-Jammu. The varieties used for study were Summer Green of cucumber, G-40 of Knol Khol, Early Green in case of Broccoli and CR-45 of Radish. Cucumber recorded highest yield of 213.85 q/ha with Neem Cake at 5 t/ha. It was 17% superior to the recommended dose of chemical fertilizers. Yields were comparatively low with farm yard manure (FYM) vermicompost and poultry manure. Knol khol gave maximum yield with full dose of NPK + seedling treatment with *Azatobactor* at the time of transplanting with superiority of 45% over sole application of chemical fertilizers. Yields were reported low with organic treatments but FYM with seedling treatment with Azatobactor yielded satisfactorily to the level of 253.3 q/ha. Broccoli responded well to INM treatment but yielded enough with FYM at 20 t/ha and poultry manure at 5 t/ha to justify its consideration of organic production. Vermicompost in combination with half dose of chemical fertilizers did excellent in broccoli and radish. However, application of FYM and vermicompost alone were superior to the use of chemical fertilizers. A yield advantage of 12 and 4% was obtained over recommended dose of chemical fertilizers with their respective application. The investigations revealed that integrated use of nutrient source is superior in application to chemical fertilizers alone. The study indicates good potential to grow these vegetables organically. Further researches are needed to find out the optimum permutations and combinations of different organic nutrient sources, so those higher yield plateaus are sustained in organic production system.

Keywords: cucumber, knoll khol, broccoli, radish, integrated nutrient management.

INTRODUCTION

The nutrient responses have been under critical evaluation to sustain higher productivity per unit area. There have been the reports of either no response to higher doses of nutrients or stagnation in the yield upon sole application of chemical fertilizers. With popularization of organic farming at the global level, there is constant haunt for nutritional sources and their applications to sustain productivity of the organic systems. Many countries have already introduced the organic production system with specific logo to provide individuality to the organic products in commercial trade (Sharma, 2011). Furthermore, the use of expensive chemical fertilizers as per the requirement of the crop is not much affordable to the average farmers in developing countries. The application of high input technologies such as chemical fertilizers, pesticides, herbicides improve the production but there is growing concern over the adverse effects of the use of chemicals on human health, soil productivity and environment quality.

Use of organic manures to meet the nutrient requirement of crops would be an inevitable practice in the years to come for sustainable agriculture. Organic manures not only improve the soil physical, chemical and biological properties but also maintain the quality of environment and plant products (Maheswarappa et al., 1999). Although the organic manures contain major

*Corresponding author. E-mail: rattanpooja16@gmail.com.

nutrients in small quantities as compared to the chemical fertilizers, but the presence of organic carbon and growth promoting principles like enzymes and hormones, make them a preferential choice for improvement of soil fertility and productivity (Bhuma, 2001). Further, the sustainability in agriculture production system refers to the capacity to remain productive while maintaining the soil fertility and increasing biodiversity. Several studies at the institutional level and at the national level have been augmented with the combined use of organic manures, bio-fertilizers and chemical fertilizers to work out the nutritional formulas that sustains higher yield with least adverse effect on soil and environment.

The present investigation was carried on major vegetables such as radish, cucumber, knol khol and broccoli to work out the integrated nutrient, as well as the organic nutrient requirements so that further direction to the research is given on organic production, as well as safe production of these vegetable crops at the commercial level. The study will also indicate the importance of combined use of organic and synthetic fertilizers in sustaining the intensive vegetable farming under subtropical agro climate.

MATERIALS AND METHODS

The present investigation was carried out at the experimental farm of SKUAST-Jammu. The experimental farm is situated at 33° 55′ N latitude and 74° 58′ E longitude at an elevation of 332 m above mean sea level. The place experiences hot dry summers, hot and humid rainy season and cool winters. Agro-climatically, the location represents zone V of Jammu and Kashmir and is characterized by subtropical climate. The important vegetables of Jammu region were selected for the study which includes cucumber, knol khol, broccoli and radish. The crops were planted in a randomized block design. The varieties used for study were Summer Green of cucumber, G-40 of Knol Khol, Early Green of case of Broccoli and CR-45 of Radish. Cucumber was transplanted in the month of January and the rest of the vegetables were transplanted/sown in the month of September. Different treatments in case of cucumber and radish were a recommended dose of NPK; 1/2 NPK + 1/2 FYM; Vermicompost at 5 t/ha; 2.5 t/ha Poultry manure + 1/2 NPK; Neem Cake at 5 t/ha; Poultry manure at 5 t/ha; FYM 20 t/ha; 1/2 Vermicompost + 1/2 NPK; and 1/2 Neem Cake + 1/2 NPK. In case of radish all the treatments were same except Neem Cake at 5 t/ha and 1/2 NPK and 1/2 Neem Cake.

100% RDF (NPK) (100:50:40); 100% FYM (20 t/ha); 75%RDF+25% FYM; 75%RDF +25% *Azatobactor* soil treatment; 50%RDF +50% FYM; 50%RDF+50% *Azatobactor* soil treatment; 100%RDF + seedling treatment with *Azatobactor;* 100%FYM + seedling treatment with *Azatobactor;* 75%RDF +25% FYM + seedling treatment with *Azatobactor;* 75%RDF +25% *Azatobactor*+ seedling treatment with *Azatobactor;* 50%RDF +50% FYM + seedling treatment with *Azatobactor;* 50%RDF +50% *Azatobactor* + seedling treatment with *Azatobactor* were used to find out their effect on morphological and yield contributing traits in knol khol. The trails were laid in a random block design with three replications. All the crops were harvested at the green edible stage. Different parameters studied in case of cucumber were number of fruits /plant; average fruit weight(g); yield/plant (g); seed cavity (cm) pericarp thickness (cm); fruit length (cm) and yield (q/ha). For recording of data ten plants were selected randomly from each plot.

For calculating seed cavity and pericarp thickness five randomly selected fruits were taken from the 3rd or 4th harvesting lots and data were then averaged to represent the population. In case of knol khol parameters observed were whole plant weight (g), leaf weight (g), leaf length (cm), Leaf width (cm), knob/leaf ratio, knob length (cm), knob width(cm), No. of leaves plant^{-1}Knob weight (g), and yield (qha^{-1}). Data were recorded on plant frame (cm), leaf Length (cm), leaf width (cm), leaf size index (cm^2), plant height (cm), curd diameter (cm^2), stem diameter(mm), number of lateral shoots, curd weight (g), weight of lateral shoots (g) and yield /plot (kg) in case of broccoli. While in case of radish important traits studied were plant height (cm), root length (cm), shoot length(cm), root weight (g), shoot weight (g), leaf number, Root/plant ratio, root diameter (cm), yield (q/ha), R+S yield (Q/ha). The data recorded was then statistically analyzed to get CD.

RESULTS

Perusal of data in Table 1 reveals that the highest number of fruits were observed when Neem Cake at 5 t/ha and FYM 20 t/ha were applied to cucumber crop, this was statistically superior to all other treatments except NPK (100:75:75). For average fruit weight per plant Neem Cake at 5 t/ha surpassed all other treatments except 1/2 Neem Cake + 1/2 NPK. Cucumbers with small seed cavity are preferred by the consumers. Smallest seed cavity was obtained when 1/2 NPK + 1/2 FYM was applied, it was statistically at par with NPK (100:75:75), 2.5 tonnes Poultry manure + 1/2 NPK and Poultry manure at 5 t/ha. However, the largest pericarp thickness was obtained when 1/2 Vermicompost + 1/2 NPK was applied which was statistically superior to all other treatments. Larger pericarp thickness is a desirable character as it is associated with enhanced self life. So for production of cucumbers for distant markets this treatment is most desirable. For yield, the best treatment which gave highest yield was Neem Cake at 5 t/ha resulting yield as high as 213.85 q/ha which was statistically at par with NPK (100:75:75), yielding to the tune of 182.98 q/ha. The role of organic manures in enhancing the growth characters is well known and they have a positive relationship with growth as indicated in the present study.

The data obtained for studying the effect of integrated nutrient management on yield and yield contributing parameters of knol khol is tabulated in Table 2. It can be inferred from Table 2 that 100%RDF + seedling treatment with *Azatobactor* resulted in highest whole plant weight which was as high as 641.33 g. This was statistically superior to all other treatments but at par with 75%RDF +25% FYM + seedling treatment with *Azatobactor* which gave 614.00 g whole plant weight. Knob/leaf ratio was maximum (1.88) when 100% RDF (NPK) (100:50:40) was applied which was statistically superior to all except 50%RDF + 50% *Azatobactor* soil treatment which gave Knob/leaf ratio as high as 1.83. Maximum yield to the tune of 438.62 q/ha was reported with the application of 100%RDF + seedling treatment with *Azatobactor.* This was superior to all the treatments except 75%RDF + 25%

Table 1. Response of integrated nutrient management in cucumber for yield and its contributing traits.

Treatment	Number of fruits/plant	Average fruit weight (g)	Yield/ plant (g)	Seed cavity (cm)	Pericarp thickness (cm)	Fruit length (cm)	Yield (q/ha)	Rank
NPK (100:75:75)	10.50	265.00	2815.00	2.65	0.80	20.00	182.98	II
NPK (50:75:75)+ 10 t/ha FYM	9.50	162.50	1537.50	2.60	0.70	16.75	99.94	VII
Vermicompost at 5 t/ha	7.00	157.50	1102.50	3.55	1.10	18.75	71.66	IX
NPK (50:75:75) +2.5 t Poultry manure	9.50	187.50	1800.00	2.70	1.15	25.50	117.00	VI
Neem Cake at 5 t/ha	11.00	300.00	3290.00	3.30	0.45	21.25	213.85	I
Poultry manure at 5 t/ha	6.50	180.00	1155.00	2.85	0.80	20.90	75.08	VIII
FYM 20 t/ha	11.00	212.50	2375.00	3.95	1.20	18.55	154.38	III
NPK(50:75:75)+Vermicompost at 2.5 t/ha	9.00	257.50	2350.00	4.25	1.40	20.30	152.75	IV
NPK (50:75:75) + at 2.5 t/ha Neem Cake	8.00	285.00	2305.00	4.25	0.95	23.05	149.83	V
CD(5%)	1.22	36.93	575.93	0.54	0.12	3.12	37.44	
CV	18.72	26.68	38.76	21.33	33.86	15.17	38.76	

Table 2. Effect of organic and integrated nutrient treatments on yield and yield contributing parameters of knol khol.

Treatment	Whole plant weight(g)	Leaf weight (g)	Knob/ Leaf ratio	Knob weight (g)	Yield/ha (q)	Rank
NPK (100:50:40)	522.93	341.16	1.88	181.77	302.0	VII
FYM(20 t/ha)	294.07	176.67	1.50	117.33	195.65	XI
NPK (75:50:40) +5.0 t/ha FYM	512.00	263.79	1.06	248.21	413.62	II
NPK (75:50:40) +*Azatobactor* soil treatment	515.67	281.86	1.20	234.11	389.96	V
NPK (50:50:40) +10.0 t/ha FYM	377.33	226.78	1.50	150.56	250.97	IX
NPK (50:50:40) +*Azatobactor* soil treatment	326.00	211.00	1.83	115.00	191.65	XII
NPK (100:50:40)+ seedling treatment with *Azatobactor*	641.33	378.06	1.43	263.27	438.62	I
FYM(20t/ha)+ seedling treatment with *Azatobactor*	395.00	242.92	1.59	152.08	253.31	VIII
NPK (75:50:40)+5.0 t/ha FYM + seedling treatment with *Azatobactor*	614.00	373.11	1.55	240.56	400.96	III
NPK (75:50:40)+soil treatment *Azatobactor* + seedling treatment with *Azatobactor*	604.33	368.77	1.56	235.56	392.63	IV
NPK (50:50:40) +10.0 t/ha FYM + seedling treatment with *Azatobactor*	481.33	332.22	2.2	149.11	248.31	X
NPK (50:50:40)+soil treatment *Azatobactor*+ seedling treatment with *Azatobactor*	420.00	238.29	1.29	183.71	305.97	VI
Control	190.67	135.47	2.45	55.20	91.99	
CD (5%)	31.21	21.40	0.25	31.24	51.32	

FYM; 75% RDF + 25% FYM + seedling treatment with *Azatobactor*; 75% RDF + 25% *Azatobactor*+ seedling treatment with *Azatobactor*; and 75% RDF + 25% *Azatobactor* soil treatment. This finding corroborates with the findings of Chattoo et al. (1997), who reported that inoculation of

Table 3. Effect of integrated nutrient management on morphological and yield contributing parameters of broccoli.

Treatment	Curd diameter (cm^2)	Number of lateral shoots	Curd weight (g)	Weight of lateral shoots (g)	Yield /plot (kg)	Rank
RDF (N:P:K=100:60:60)	11.0	6.1	140.0	550.0	300.0	VI
FYM at 20 t/ha	11.5	7.0	136.0	450.0	340.5	II
FYM at 10 t/ha+NPK (50:60:60)	10.50	7.1	142.0	530.0	295.5	VI
Neem Cake at 5 t/ha	10.50	5.5	150.0	560.0	205.0	VIII
Neem Cake at 2.5 t/ha+ NPK (50:60:60)	10.75	6.0	150.0	525.0	320.0	IV
Vermicompost at 5 t/ha	10.5	5.5	141.0	625.0	298.5	V
Vermicompost at 2.5 t/ha+ NPK (50:60:60)	10	6.0	140.0	600.0	345.0	I
Poultry manure at 5 t/ha	11.05	6.0	146.0	580.0	321.0	III
Poultry manure at 2.5 t/ha+ NPK (50:60:60)	10.50	5.5	130.5	500.0	275.5	VII
CD (5%)	3.0	1.1	5.2	19.0	5.2	

azatobactor markedly increase growth, yield and quality in knol khol; Prabhu et al. (2006) revealed that application of 50% recommended dose of fertilizers + vermicompost at 2 t/ha + biofertilizers resulted in maximum yield in cucumber. Data recorded on effect of organic and integrated nutrient management on morphological and yield contributing parameters of broccoli is presented in Table 3. Data obtained thus revealed that no statistical difference was observed for the curd diameter (cm^2). Maximum number of lateral shoots were observed when FYM at 10 t/ha + 1/2 NPK (chemical fertilizers was applied). This surpassed all the treatments except FYM at 20 t/ha, and RDF (N:P:K=100:60:60). Neem Cake at 5 t/ha and Neem Cake at 2.5 t/ha +1/2 NPK (chemical fertilizer) resulted in maximum curd weight that is 150.0 g. it was statistically superior to all the treatments except Poultry manure at 5 t/ha (146.0 g). For getting higher yield treatment of Vermicompost at 2.5 t/ha+1/2 NPK (chemical fertilizers) was found most suitable, as it resulted in yield/plot as high as 345.0 kg, which was statically higher than all the treatments except FYM at 20 t/ha.

Data obtained with respect to various treatments on yield and yield contributing characters in radish (Table 4) showed that there was no statistical difference among the treatments for root length (cm) and shoot length. The maximum root diameter (4.01 cm) was obtained when vermicompost at 5 t/ha + ½ recommended dose of N (30 kg) and full dose of P (30 kg) and K (50 kg) (through chemical fertilizers) was applied. Vermicompost at 5 t/ha + ½ recommended dose of N (30 kg) and full dose of P (30 kg) and K (50 kg) (through chemical fertilizers) resulted in maximum yield that is 630.0 q/ha. This was statically superior to all other treatments except Poultry manure at 2.5 t/ha + half N and Full P and K (30, 30, 50) through chemicals, which resulted in yield as high as 555.0 q/ha.

DISCUSSION

Integrated nutrient management studies in cucumber revealed that for yield, best treatment which gave highest yield was Neem Cake at 5 t/ha which was statistically at par with NPK (100:75:75). The role of organic manures in enhancing the growth characters is well known and they have a positive relationship with growth as indicated in the present study. Organic manures were efficient than inorganic fertilizers, whereas the combined use of organic with inorganic fertilizers was considered to be superior to the use of organic fertilizer alone (Sharma, 1991). The better efficiency in combination with inorganic fertilizers might be due to the fact that organic manures would have provided the micronutrients such as zinc, iron, copper, manganese, etc., in an optimum level. Zinc is involved in the biochemical synthesis of the most important plant hormone, Indole Acetic Acid through the pathway of conversion of tryptophan to IAA. Iron is involved in the chlorophyll synthesis pathway. Application of organic manure would have helped in the plant metabolic activity through the supply of such important micronutrients in the early crop growth phase, which in turn encouraged early vigorous growth (Anburani and Manivannan, 2002).

The data obtained for studying the effect of integrated nutrient management on yield and yield contributing parameters of knol khol revealed maximum yield with the application of 100% RDF + seedling treatment with *Azatobactor.* This was superior to all the treatments except 75% RDF + 25% FYM; 75% RDF + 25% FYM + seedling treatment with *Azatobactor*; 75% RDF + 25% *Azatobactor* soil treatment + seedling treatment with *Azatobactor*; and 75% RDF + 25% *Azatobactor* soil treatment.

These finding corroborates with the findings of Chattoo et al. (1997), who reported that inoculation of Azatobactor markedly increase growth, yield and quality in knol khol; Prabhu et al. (2006) revealed that application of 50% recommended dose of fertilizers + vermicompost at 2 t/ha + biofertilizers resulted in maximum yield in cucumber. The stimulative effect of *Azotobacter* might be attributed to its efficiency in supplying the growing plants with biologically fixed nitrogen, dissolved immobilized phosphorus and produced phytohormones, further these

Table 4. Effect of INM treatment on yield and yield contributing characters in radish.

Treatment	Root length (cm)	Shoot length (cm)	Root diameter (cm)	Yield (q/ha)	Rank
NPK (60:30:50)	29.33	38.73	3.57	470.0	VI
Poultry manure at 2.5 t/ha + N:P:K (30:30:50)	30.87	38.53	3.76	555.0	II
Poultry manure at 5 t/ha	30.07	34.67	3.39	425.0	VII
Vermicompost at 5 t/ha + N:P:K (30:30:50)	31.87	36.20	4.01	630.0	I
FYM at 20 t/ha	30.53	35.07	3.59	490.0	III
Vermicompost at 10 t/ha	31.40	35.60	3.66	527.0	IV
FYM at 10 t/ha + N:P:K (30:30:50)	31.40	38.33	3.74	515.0	V
CD 5%	3.57	4.38	0.67	76.5	

could stimulate nutrients absorption, as well as photosynthesis process which subsequently increased plant growth and yield (Hewedy, 1999). Data recorded on effect of organic and integrated nutrient management on morphological and yield contributing parameters of broccoli suggests that for getting higher yield treatment of Vermicompost at 2.5 t/ha+1/2 NPK (chemical fertilizers) would be most suitable as it resulted in maximum yield/ plot, which was statically higher than all the treatments except FYM at 20 t/ha. These results are in line with the findings of Sharma (2000) in which he found that integration of organic and inorganic fertilizers application significantly increased the head yield over inorganic fertilizers alone and also over control. Higher yields with the application of Vermicompost in combination of recommended dose of NPK was also reported by Ranjit (2010). Present investigation reveals that partial substitution of inorganic fertilizers through vermicompost is highly effective and higher levels of vermicompost emerged as better organic source over that of farmyard manure.

Data obtained with respect to various treatments on yield and yield contributing characters in radish showed that vermicompost at 5 t/ha + ½ recommended dose of N (30 kg) and full dose of P (30 kg) and K (50 kg) (through chemical fertilizers) resulted in maximum yield. This was statistically superior to all other treatments except poultry manure at 2.5 t/ha + half N and Full P and K (30, 30, 50) through chemicals. It is very likely that when we apply enriched compost along with chemical fertilizers, compost not only slowly releases nutrients from it but also prevents the losses of chemical fertilizers through denitrification, volatilization and leaching by binding the nutrients and releasing with the passage of time. Thus, compost prevents nutrients losses (Arshad et al., 2004). Hence, the increase in the growth and yield of radish could be attributed to enhanced nutrient use efficiency in the presence of organic fertilizer being an excellent source of macro- and micro-nutrients (Asghar et al., 2006).

The present investigation indicated that organic cultivation of cucumber, knol khol broccoli and radish is possible. Neem cake proved good source of nitrogenous fertilizer in case of cucumber. While to vermicompost application all vegetables responded well. Quite high yields are possible in case of broccoli and radish. In all the crops studied, integrated nutrient application that is combined use of organic, synthetic and bio-fertilizers showed highly positive effects on yield and yield contributing characters. Keeping in view the high yields of broccoli and radish with exclusive application of organic manures, their cultivation at commercial level is proposed to be first choice to promote organic farming in non-traditional areas.

REFERENCES

Anburani A, Manivanna K (2002). Effect of integrated nutrient management on growth in brinjal (*Solanum melongena* L.) cv. Annamalai. South Indian Hort., 50(4-6): 377-386.

Arshad M, Khalid A, Mahmood MH, Zahir ZA (2004). Potential of nitrogen and Ltryptophan enriched compost for improving growth and yield of hybrid maize. Pak. J. Agric. Sci., 41: 16-24.

Bhuma M (2001). Studies on the impact of humic acid on sustenance of soil fertility and productivity of greengram. MSc (Ag) Thesis, TNAU, Coimbatore.

Chattoo MA, Gandroo MY, Zargar MY (1997). Effect of Azospirillium and azatobacter on growth yield and quality of knol khol (Brassica oleracea var. gongylodes L.). Veg. Sci., 24 (1): 16-19.

Asghar HN, Ishaq M, Zahir* ZA, Khalid M, Arshad M (2006). Response of radish to integrated use of nitrogen fertilizer and recycled organic waste. Pak. J. Bot., 38(3): 691-700

Hewedy AM (1999). Influence of single and multi-bacterial fertilizer on the growth and fruit yield of tomato. Egypt. J. Appl. Sci., 14: 508-523.

Prabhu M, Natarajan S, Srinivasan K, Pugalendhi L (2006). Integrated nutrient management in cucumber. Indian J. Agric. Res., 40 (2): 123-126

Maheswarappa HP, Nanjappa HV, Hegde MR, Balu SR (1999). Influence of planting material, plant population and organic manures on yield of East Indian Galangal and on soil physiochemical and biological properties. Internet Paper Accesed on 7/09/09.

Ranjit C (2010). Physiological Attributes of Cabbage (*Brassica Oleracea*) as Influenced by Different Sources of Nutrients under Eastern Himalayan Region. Res. J. Agric. Sci., 1(4): 318-321.

Sharma AC (1991). Nitrogen Management in Potato Tech. Bull. No. 32, Central Potato Research Institute, Shimla, p.74.

Sharma KC (2000). Influence of integrated nutrient management on yield and economics in broccoli (*Brassica oleracea* L. var *Italica*) plenck under cold temperate conditions. Veg. Sci., 27(1): 62-63.

Sharma JP (2011). Organic Vegetables: production and protection technology In: quality seed production of vegetable crops. Vol. I (Ed. J. P. Sharma). Kalyani Publishers New Delhi, pp. 123-143.