Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 319-322
Received: 09-11-2018
Accepted: 14-12-2018

Sunil Kumar Dash
Vegetable Agronomist, AICRP on Vegetable Crops, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India

Menka Pathak
Ph.D., Scholar, Vegetable Science, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

L Tripathy
Associate Professor, College of Horticulture, Chiplima, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Satyaprakash Barik
Ph.D., Scholar, Vegetable Science, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Correspondence
Sunil Kumar Dash
Vegetable Agronomist, AICRP on Vegetable Crops, Odisha University of Agriculture and Technology, OUAT, Bhubaneswar, Odisha, India

Studies on effect of integrated nutrient management on growth and yield attributes in radish (*Raphanus sativus* L.) and its residual effect in coriander (*Coriandrum Sativum* L.) in radish-coriander cropping sequence

Sunil Kumar Dash, Menka Pathak, L Tripathy and Satyaprakash Barik

Abstract
Field experiment on Radish-Coriander Cropping Sequence was conducted at the field site of AICRP on Vegetable Crops of O.U.A.T., Bhubaneswar, Odisha India during *Rabi* season of 2016-17 to find out a suitable combination of chemical fertilizers and organic manure for sustainable crop yield. The eight treatments schedules were T_1: Conventional practices (Recommended FYM @ 20 tha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} +PP chemicals), T_2: Vermicompost @ 12.5t ha^{-1} (PP with organic methods), T_3: FYM @ 20t ha^{-1} (PP with organic methods), T_4: T_1 + IIHR microbial consortium @ 12.5 kg ha^{-1}), T_5: T_2 + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods), T_6: T_3 + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods), T_7: Safe production (Recommended FYM @ 20t ha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} + PP with organic methods) + IIHR microbial consortium @ 12.5 kg ha^{-1} and T_8: *Azospirillium* + PSB @ 4 kg ha^{-1}(Control).The treatments were arranged in Randomized Block Design with three replications. Results revealed that adoption of either safe production (T_7) or conventional practices (T_4) had significant positive influence on vegetative growth, *viz;* plant height (31.74-33.50cm), leaves $plant^{-1}$(10.27-10.47),yield and yield attributing parameters, *viz;* root length (15.24 - 15.67 cm), root circumference (9.69-10.23 cm) and average root weight (152.63 – 160.26g), radish root yield (23.55 – 24.00 kg $plot^{-1}$ and 290.72 – 296.28 q ha^{-1}). Similar trend was also observed in coriander when grown on residual fertility of succeeding crop, radish with significantly better influence on vegetative growth, *viz;* plant height (15.20-16.39 cm), leaves $plant^{-1}$(5.83-6.18). However, significantly highest leaf yield was observed in T_2 and T_6 (4.53-4.60 kg $plot^{-1}$ and 55.93-56.79 qha^{-1}).

Keywords: Integrated nutrient management, radish, coriander, cropping sequence

Introduction
Farmers are following different cropping sequence in different areas of the country depending on soil type, crop suitability and climatic conditions. Radish-Coriander cropping sequence is now being practiced in the homestead of the country. Generally, farmers use only chemical fertilizers with little or no organic manure for individual crop without considering cropping pattern for the whole year. As a result, large amount of fertilizers are being misused every year in pattern based crop cultivation. Organic matter and fertility status of Bhubaneswar soil is very low. Now it is well agreed that depleted soil fertility is a major constraint for higher crop production in Bhubaneswar and indeed, yield of several crops is declining in some soils. Moreover, less or no use of organic manure impairs soil physical, chemical, and biological properties. The beneficial effects of organic manure in vegetable production were demonstrated by many workers Subhan (1991) [14], Khan *et al.* (2008) [3], Islam (2009) [1]. Nitrogenous fertilizers have very little residual effects on the following crops, as it is lost through leaching, volatilization and denitrification. But phosphorous, potassium, fertilizers might have residual effects for the subsequent crops. Thus, the fertilizer requirements for the succeeding crops in the cropping pattern may be considerably reduced if the residual benefit is taken into account. On the other hand, organic manure improves soil health and productivity. *Noor et al*. (2005) [6], (2006) [7] and (2007a, b) [8, 9] conducted several on-station trials for several vegetable based patterns. Now, on-farm verification trials are required. Considerable work has been done on the residual effects of organic manure and chemical fertilizers on the succeeding crops in root leafy vegetable based cropping patterns in Odisha condition, but work on inclusively vegetable cropping patterns is scarce.

The present study was undertaken for the Radish-Coriander cropping pattern at AICRP Vegetable Crops of OUAT, Bhubaneswar of Odisha with the objectives of minimizing the use of chemical fertilizers through the use of organic manure and finding out the suitable combination of chemical fertilizers and organic manure for sustainable crop yield.

Materials and Method

The experiment was carried out during the *Rabi* season of 2016-17 at the All India Coordinated Research Project (AICRP) on Vegetable Crops, Orissa University of Agriculture and Technology (OUAT).The experiment was laid out in Randomized Block Design with three replications having plot size of 3 X 2.7m. There were eight treatment consisting T_1:Conventional practices (Recommended FYM @ 20 tha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} +PP chemicals), T_2: Vermicompost @ 12.5t ha^{-1} (PP with organic methods), T_3: FYM @ 20t ha^{-1} (PP with organic methods), T_4: T_1 + IIHR microbial consortium @ 12.5 kg ha^{-1}), T_5: T_2 + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods), T_6: T_3 + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods), T_7: Safe production (Recommended FYM @ 20t ha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} + PP with organic methods) + IIHR microbial consortium @ 12.5 kg ha^{-1} and T_8: *Azospirillium* + PSB @ 4 kg ha^{-1}(Control) on growth and yield of carrot. The chemical fertilizers were used in form of urea, Single Superphosphate and Muriate of potash for N, P_2, O_5 and K_2O, respectively. All the organic manures, including FYM, Vermicompost were incorporated in soil 15 days before sowing. Full dose of Diammonium Phosphate (DAP) and Muriate of Potash (MOP) along with one third of urea applied as basal dressing in two spilt doses at 15 and 30 days after sowing. Biofertilizer cultures (*Azospirillum* + Phosphate solubilizing bacteria (PSB) were applied @ 4 kg ha^{-1} in 10:12 ratio. These were first incubated in FYM and then applied to T_8 plot after sowing of the seeds as per the treatment details. However, in all other treatments, Arka Microbial Consortium of IIHR, Bangalore was applied, as per the treatment scheduled. In the present experiment, radish seeds of variety Pusa Chekti long were sown in well prepared plots with a row spacing of 30 cm while that of coriander variety Mahak with a row spacing of 20 cm. First irrigation was given soon after sowing and thereafter at 10 to 15 days interval depending upon the crop growth and soil moisture status, for both radish & coriander crop. The thinning and weeding operations were done at 15 days after sowing in order to maintain the plant population as per spacing. Precautionary two sprays of neem oil @ 5 ml l^{-1} were sprayed against insects & pests specially aphids in the radish crop. Due to large population of plants in the plots, it was rather difficult to record the observation in each plant in the experiment field. Since, all the plants have equal opportunity their growth and development. Therefore, a technique of random sampling was adopted for recording observations on various growth and yield attributes during the course of investigation. A sample of ten plants from each plot was drawn randomly and tagged for recording observation like growth attributes as well as yield and yield attributes. The observations of plants were recorded at regular interval throughout their life cycle to measure the relationship between growth attributes and attributes at harvest. All the measurements were taken at successive interval of crop growth.

Statistical analysis

The experiment was laid out in a Randomized Block Design (RBD) with 8 treatments and 3 replications. 'F' test was done to find out significance [Panse and Sukhatme, (1985) [11]].The appropriate standard error of means was calculated in all cases and critical difference was calculated for comparing the treatment means where over 'F 'test was significant.

Results and Discussion

Effect of integrated nutrient management on growth attributes

The data presented in Table -1 revealed significant variations among the treatment on growth and yield of radish- coriander cropping sequence. The maximum height of plant and length of leaves were recorded by the use of treatment T_7(Safe production (Recommended FYM @ 20t ha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} + PP with organic methods) + IIHR microbial consortium @ 12.5 kg ha^{-1}) followed by T_4(Conventional practices Recommended FYM @ 20tha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} +PP chemicals + IIHR microbial consortium @ 12.5 kg ha^{-1}) and T_1 (Conventional practices Recommended FYM @ 20tha^{-1} + fertilizer @ 80:60:80 NPK kg ha^{-1} +PP chemicals),.This is obviously indicated that the integrated use of nutrients in cell elongation in meristemetic region of plant beside production of growth promoting substances might have brought improvement in height and leaves as well. On the other hand, significantly wide variations were also recorded for plant height at harvest, No of branches$plant^{-1}$ in coriander crop in Table -2.When grown on residual soil fertility of radish crop, was recorded in T_1 than rest of the nutrient management. This might be due to favorable environment created by integrated application of RDF + FYM @ 20 tha^{-1} with or without IIHR consortium @ 12.5 kg ha^{-1} (Arka microbial consortium). Increased vegetative growth of radish in the present study due to integrated application of RDF + FYM @ 20 t ha^{-1} with (T_7) or without (T_1) Arka microbial consortium might be due to availability of more nutrients during crop growth period in radish. Organic matter might have created favourable environment for better root growth and development (Islam *et al*, (2010) [2]. The present findings are in conformity with the findings of Vasmate *et al*. (2007) [15], Vasmate *et al*. (2008) [16] and Moslemi *et al*. (2012) [5]. The results on residual effects of applied nutrient management practices to radish on coriander as succeeding crop on vegetative growth parameter clearly demonstrated significant influence on these parameters. However, in most of the parameters similar results were observed. That means the nutrient management practices such as T_1, T_4 and T_7 have significantly better impact not only on preceding crop, radish but also on succeeding crop, coriander. The results clearly established the integrated application of inorganic fertilizers with organic manure with or without Arka microbial consortium have significant impact in radish- coriander cropping sequence. The present results are in agreement with Reddy (2007) [12] in maize- soybean cropping system. According to Laxmi *et al*. (2014) [4], application of green manure + castor cake @ 6 t ha^{-1}+ Biofertilizer to the proceeding green manure + marigold had marked effect in improving vegetative growth parameters of radish as residual effect.

Effect of Integrated Nutrient Management on yield and yield attributes

The results of present study revealed that significantly better results were observed on yield attributing parameters with application of treatment T_1, T_4 and T_7 as compared to other treatments as whole. The length of root (cm), root diameter (cm), root yield (qha^{-1}), shoot yield (qha^{-1}) and plot yield(Kg

plot^{-1}) in Table 1.On the other hand, coriander when grown on residual nutrient management practices of radish crop, showed significant variations for leaf yield plot^{-1}.Significantly highest yield plot^{-1} of 4.60 kg was recorded in T_2 closely followed by T_6 (4.53 kg) than T_3 (4.38 kg) and T_5 (3.92 kg), which was *statically at par* with each other in Table 2. The results simply indicated that as a first crop, radish, integrated application of organic manures (FYM) along with RDF with or without Arka microbial consortium had significantly influence on root yield attributing parameters. Integrated application of inorganic fertilizer + FYM had positive increased in growth of the plants, in turn the yield attributing parameters. This might be due to faster in cell division, multiplication and cell elongation in meristematic region of the plant due to production of plant growth substances by FYM (Sharma, 2012)[13]. Better efficacy of these treatments might be attributed to the availability of more nutrients and slow release coincides with the stage of root development in radish mixed with increased root growth and aeration of root growth. The results on yield attributing parameters of nutrient management of radish to succeeding crop, coriander also revealed significant variations with respect to days taken to harvest, fresh and dry weight. Invariably, as residual effect, both the treatment T_7 and T_4 were found better than other treatments. The results also showed that in almost all treatments with inoculation of Arka microbial consortium @ 12.5 kg ha^{-1} revealed significantly better results as residual effect which clearly demonstrated the role of microbial population in maintaining the soil fertility. The improvement in both vegetative growth and yield attributes due to inoculation of biofertilizer along with organic and inorganic fertilizers might be due to the beneficial effect of biofertilizer on N- fixation, production of phytohormone like substances and increases in uptake of nutrients such as nitrogen.

In cropping sequence, the results revealed better efficacy of integrated application of RDF + FYM + Arka microbial consortium (T_4 and T_7) in Radish – Coriander cropping sequence. This might be due to availability of more nutrients for a long period of time to both 1st and 2nd crop. Further, the increased of microbial population due to increased availability of substrate high organic manures, FYM. Similar reports were also reported by Laxmi *et al*. (2014) [4] in Marigold – Radish while Reddy *et al.* (2005) [11] in Onion- Radish Cropping System. Noor *et al.* (2007a) [8] observed a good harvest of okra as a second crop under broccoli-okra cropping sequence following integrated nutrient management approach. A package of 75% chemical fertilizers along with 5 t PM/ha for radish and tomato while 75% recommended N along with 2.5 t PM/ha for red amaranth and Indian spinach was found beneficial under radish-tomato-red amaranth-Indian spinach cropping pattern (Noor *et al*., 2007b) [9].

Table 1: Effect of Integrated Nutrient Management on vegetative growth and yield parameters of radish in Radish- Coriander Cropping Sequence

Treatments		Plant height at final harvest (cm)	Root Length (cm)	Shoot Length (cm)	Root Diameter (cm)	Average Root weight (g)	Plot Yield (kg)	Root Yield (qha^{-1})	Shoot Yield (qha^{-1})
T_1	Conventional practices (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals)	34.52	15.19	28.23	9.30	143.10	45.45	258.62	302.45
T_2	Vermicompost @ 12.5tha^{-1} (PP with organic methods)	21.26	12.99	18.70	8.81	96.38	23.78	182.45	111.10
T_3	FYM@20tha^{-1} (PP with organic methods)	23.83	15.01	17.70	8.96	96.48	30.77	211.96	167.89
T_4	Conventional practices (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals)+IIHR microbial consortium @ 12.5 kg ha^{-1}	31.74	15.67	25.27	9.69	152.63	48.65	290.72	309.85
T_5	Vermicompost @ 12.5tha^{-1} + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods)	22.07	14.06	16.20	9.07	113.23	22.60	169.74	109.26
T_6	FYM@20tha^{-1} +IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods)	24.24	15.79	17.73	9.09	99.47	23.32	134.56	153.33
T_7	Safe production (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals) + IIHR microbial consortium @ 12.5 kg ha^{-1}	33.50	15.24	26.69	10.23	160.26	49.37	296.28	313.19
T_8	*Azospirillium* + PSB (Control)	21.59	12.02	12.83	7.73	90.49	13.51	84.16	82.63
	Mean	26.59	14.50	20.42	9.11	119.00	32.18	203.56	193.71
	SE (m) ±	1.21	1.10	1.76	0.60	12.44	2.18	19.23	15.44
	$CD_{0.05}$	2.60	2.36	3.78	1.30	26.68	4.69	41.25	33.13
	CV	5.58	9.28	10.56	8.13	12.80	8.31	11.57	9.76

Table 2: Effect of Integrated Nutrient Management on vegetative growth and yield parameters of residual effect of coriander in Radish-Coriander Cropping Sequence

Treatments		Plant height at final harvest	No. of branches plant^{-1}	Average wt of 10 plant	Marketable Yield (Kg/Plot)	Marketable Yield (q/ha)
T_1	Conventional practices (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals)	34.52	6.20	19.33	3.64	44.98
T_2	Vermicompost @ 12.5tha^{-1} (PP with organic methods)	21.26	6.27	22.73	4.60	56.79
T_3	FYM@20tha^{-1} (PP with organic methods)	23.83	5.43	23.27	4.38	54.03
T_4	Conventional practices (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals)+IIHR microbial consortium @ 12.5 kg ha^{-1}	31.74	5.83	23.93	2.78	34.36
T_5	Vermicompost @ 12.5tha^{-1} + IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods)	22.07	6.43	22.00	3.92	48.44
T_6	FYM@20tha^{-1} +IIHR microbial consortium @ 12.5 kg ha^{-1} (PP with organic methods)	24.24	6.03	20.67	4.53	55.93

T_7	Safe production (Recommended FYM@20tha^{-1} + fertilizer@80:60:80 NPK kg ha^{-1} +PP chemicals) + IIHR microbial consortium @ 12.5 kg ha^{-1}	33.50	6.18	23.47	3.44	42.51
T_8	*Azospirillium* + PSB (Control)	21.59	4.13	16.87	2.43	30.00
	Mean	26.59	5.81	21.53	3.72	45.88
	SE (m) ±	1.21	0.61	1.67	0.41	5.05
	$CD_{0.05}$	2.60	1.31	3.59	0.88	10.84
	CV	5.58	12.86	9.52	13.49	13.49

Conclusion

Integrated nutrient management treatments rendered their significant effect on almost all the vegetative growth characters and yield attributing characters of Radish cv. Pusa chekti. Results revealed that adoption of either safe production (T_7) or conventional practices (T_4) had significant positive influence on vegetative growth, *viz;* plant height (31.74-33.50cm), leaves plant^{-1}(10.27-10.47),yield and yield attributing parameters, *viz;* root length (15.24 - 15.67 cm), root circumference (9.69-10.23 cm) and average root weight (152.63 – 160.26g), radish root yield (23.55 – 24.00 kg plot^{-1} and 290.72 – 296.28 q ha^{-1}). Similar trend was also observed in coriander cv. Mahak when grown on residual fertility of succeeding crop, radish with significantly better influence on vegetative growth, *viz;* plant height (15.20-16.39 cm), leaves plant^{-1}(5.83-6.18). However, significantly highest leaf yield was observed in T_2 and T_6 (4.53-4.60 kg plot^{-1} and 55.93-56.79 qha^{-1}).

Reference

1. Islam MM. Integrated nutrient management for homestead gardening in Gazipur. Ph.D., Thesis. Bangabandhu Sheikh Mujibur Rahman Agric. Univ., Gazipur, 2009.
2. Islam MM, Karim AJMS, Jahiruddin M, Majid MK, Miah GM, Ahmed MM *et al*. Effect of organic manure and chemical fertilizer on crops in the radish-stem amaranthus – Indian spinach cropping pattern in homestead area. Australian Journal Crop Science. 2010; 5(11):1370-1378
3. Khan MS, Shil NC, Noor S. Integrated nutrient management forsustainable yield of major vegetable crops in Bangladesh. Bangladesh J Agric. And Environ. 2008; 4:81-94.
4. Laxmi P, Pratap M, Rao AM. Effect of residual fertility of preceding marigold crop on growth, yield and nutrient uptake of radish (*Raphanus sativus* L.) crop. Research on Crops, 2014; 15(1):175-179.
5. Moslemi M, Aboutalebi A, Hasanzadeh H, Farahi MH. Evaluation of the effects of different levels of vermicompost on yield and yield components of Coriander (*Coriandrum sativum* L.). Annuals of Biological Research. 2012; 3:4852-4853.
6. Noor S, Shil NC, Sultana S, Farid ATM. Evaluation of some organic manure on the yield of cabbage under integrated nutrient management system. Bangladesh J Agric. and environment. 2005; 1(2):53-59.
7. Noor S, Shil NC, Islam MM, Farid ATM. Efficiency of organic manures on the yield of tomato grown under integrated nutrient management approach. Bangladesh J Environ, Sci. 2006; 12(1):141-145.
8. Noor S, Shil NC, Haque MA, Farid ATM. Integrated Nutrient Management for Brocolli-Okra cropping sequence. J Asiat. Soc. Bangladesh, Sci. 2007a; 33(1):85-94.
9. Noor S, Shil NC, Farid ATM. Integrated Nutrient Management for Radish-Tomato-Red Amaranth-Indian Spinach cropping pattern in the Homestead area. Bangladesh. J Agric. Research. 2007b; 32(1):17-28.
10. Panse VS, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, 1985, 152-155.
11. Reddy KC, Reddy KM. Differential levels of vermicompost and nitrogen on growth and yield of onion (*Allium cepa* L.) Radish (*Raphanus sativus* L) cropping system. J Research. ANGRAU. 2005; 33(1):11-17.
12. Reddy KPC. Effect of integrated use of inorganic and organic sources of nutrients in maize-groundnut cropping system of Alfisols. Ph.D., Thesis. Acharya N G Ranga Agricutural University, Hyderabad, 2007.
13. Sharma PJ, Ratan P, Kumar S. Response of vegetable crops to use of integrated nutrient management practices. SABB Journal of food and Agriculture Science. 2012; 2(1):15-19.
14. Subhan. Effect of organic materials on growth and production of cabbage (*Brassica oleracea* L.). Soils and Fert. 1991; 54(4):587.
15. Vasmate SD, Patil RF, Manolikar RR, Kalabandi BM, Digrase SS. Effect of spacing and organic manures on growth of coriander (*Coriandrum sativum* L.). The Asian Journal of Horticultre. 2007; 2(2):266-268.
16. Vasmate SD, Patil RF, Manolikar RR, Kalabandi BM, Digrase SS. Effect of spacing and organic manures on seed of coriander (*Coriandrum sativum* L.). The Asian Journal of Horticultre. 2008; 3(1):127-129.