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EVALUATION OF ORGANIC FARMING *vis-à-vis* FARMING WITH INTEGRATED NUTRIENT MANAGEMENT SYSTEM IN SOYBEAN (*Glycine max L.)* – ONION (*Allium cepa L.*) CROPPING SEQUENCE

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ABSTRACT

The investigation on "Evaluation of organic farming vis-à-vis farming with integrated nutrient management system in soybean-onion cropping sequence" was carried out during 2006-2007 and 2007-2008 for two successive years at All India Coordinated Research Project on Cropping Systems Farm, Mahatma Phule Krishi Vedyapeeth, Rahuri, District of Ahmednagar, Maharashtra State, India. The experiment was laid out in Randomized Block Design (RBD). There were eight treatment combinations for kharif and rabi season and these treatments were replicated four times during both the years. The results of the yield of soybean, onion and onion equivalent yield in soybean-onion cropping sequence was significantly higher in the application of 100% NPK recommended dose followed by 50% NPK recommended dose combined with 50% N through FYM as compared with other treatments. All the treatments with organic sources exhibited significantly higher yield of soybean, onion and onion equivalent yield than control. The pooled mean maximum gross monetary returns over two years (Rs 148971 ha^{-1}), B:C ratio (2.87) and Sustainable Value Index (SVI) (0.78) were recorded in 100% NPK recommended dose fertilizer. The treatments of organic sources gave significantly higher pooled mean gross monetary returns, net monetary returns and B:C ratio as compared with control.

Key word: soybean, onion, organic farming, yield, economics, soybean-onion cropping sequence.

INTRODUCTION

In India, vegetable oils have gained enormous importance particularly in view of the deficit production and availability. Soybean is an excellent source of protein and oil. It contains 38 to 43 per cent protein, 18-20 per cent oil, 4 per cent minerals and 2 per cent phosphor-lipids (Haldankar *et al*, 1992).

Onion, *Allium cepa*, is one of the leading vegetable crops worldwide, grown for its culinary purposes and medicinal values. In 2003, it was cultivated in more than 175 countries, on nearly 3 million ha, producing more than 50 million tonnes. India is the second largest producer of onion after China (Scholten and Van Bruggen, 2007). About 80,000 tonnes of pesticides are used in agriculture annually. In the last decade in India consumption of chemicals in the form of nitrogen, phosphorous, and potassium has grown at 9.5 per cent annually, making India the fourth largest consumer of fertilizer in the world (Shiva *et al*, 2004). In addition, the estimated total potential demand for biofertilizers in India is using more million tonnes per year (Phadke, 2001). Composting manure is becoming more popular. In comparison with manure, compost is a more stable product since almost all of the nutrient fractions are in an organic form and the material is semi decomposed. Plants can uptake majority of nutrients in an inorganic form (Wiederholt *et al.,* 2005). Therefore, present investigation on "Evaluation of organic farming *vis-à-vis* farming with integrated nutrient management system in soybean-onion cropping sequence" was planned with following objectives: Evaluation of yield and economics in soybean-onion cropping sequence.

MATERIALS AND METHODS

The investigation on "Evaluation of organic farming vis-à-vis farming with integrated nutrient management system in soybean-onion cropping sequence" was carried out during 2006-2007 and 2007-2008 for two successive years at All India Coordinated Research Project on Cropping Systems Farm, Mahatma Phule Krishi Vedyapeeth, Rahuri, District of Ahmednagar, Maharashtra State, India. The soil of experimental field was sandy clay loam in texture, low in nitrogen, medium in phosphorus, fairly rich in potash, low in organic carbon content and slightly alkaline in reaction with pH 8.36.

The experiment was laid out in Randomized Block Design (RBD) during *kharif* and *rabi* season with eight treatments and four replications. Variety was used Cv. DS-228 for soybean and Cv. N-2-4-1 for onion. The gross and net plot sizes were 9.00 m x 4.50 m and 8.40 m x 3.30 m, respectively. These plot sizes were used for both the years of experimentation. The soybean crop was sown at a spacing of 30 cm x 10 cm during *kharif* season and onion was planted at a spacing of 15 cm x 10 cm during *rabi* season.

The treatment details along with the symbols used are given below: T_1: 50% NPK recommended dose combined with 50% N through FYM + micronutrient as per soil test; T_2: 1/3 recommended N each through FYM, vermicompost and neem seed cake; T_3: T_2 + trap crop (sannhemp); T_4: T_2 + Agronomic practices the hand weeding and IPM technique for pest control; T_5: 50% N through FYM + *Rhizobium/Azotobacter* + PSB; T_6: T_2 + *Rhizobium/Azotobacter* + PSB; T_7: 100% NPK recommended dose and T_8: Control (no fertilizer application).

* Recommended dose for soybean was 50:75:00 kg ha^{-1} (N: P_2O_5:K_2O)
* Recommended dose for onion was 100: 50: 50 kg ha^{-1} (N: P_2O_5:K_2O)
* Zine sulphate was used one time with 20 kg ha^{-1} in first season of soybean crop.
* Sannhemp grown between two rows of soybean in treatment T_3 and it was incorporated in the soil at 40 days after sowing. In IPM technique of trap crops like cordianer, marigold, maize and sorghum were grown around of the boundary to pests attack on soybean in treatment T_4.

The soybean crop was dibbled on 2nd July 2006 and 26th June 2007 as per treatments during first and second year, respectively. Two seeds per hill were dibbled at a spacing of 10 cm. Fertilizers were applied as a basal dose as per the treatments where nitrogen and phosphorus were applied uniformity in the form of urea and single super phosphate by band placement method just before dibbling of soybean. The farm yard manure, vermicompost and neem seed cake were applied well before the sowing soybean as per the treatments. The seeds were inoculated with *Rhizobium* and phosphate solubilizing bacteria (PSB) @ 250 g each for 10 kg of seed just before dibbling as per treatments. After inoculation seeds were dried in shade for about one hour and then used for dibbling. Similar procedure was followed during both the years.

The seed of onion variety was N-2-4-1 was used in the experiment. The transplanting of seedling was done on November 18-19th, 2006 during first year while during second year it was done on December 27-28th, 2007. Measured quantity of straight fertilizer viz., urea (46% N) single super phosphate (16% P_2O_5) and marinate of potash (60% K_2O) were used uniformly as a basal dose and top dressing of N. Half dose of nitrogen and full dose of phosphorus and potassium were applied immediately after transplanting and remaining half dose of nitrogen was applied as top dressing one month after transplanting as per treatments. The farm yard manure, vermicompost and neem seed cake were applied well before the transplanting of onion as per the treatments. The seedlings roots of onion were inoculated with *Azotobacter* and phosphate solubilizing bacteria (PSB) (@ 250 g each for 1 kg of seed) just before transplanting as per treatments.

The onion equivalent yield was calculated by the following equation for respective treatments:

$$\text{Onion equivalent} = \frac{\text{Seed yield of soybean (q / ha) x Market rate of soybean / q}}{\text{Market rate of onion / q}} = \text{Onion yield (q / ha)}$$

Sustainable Value Index (SVI) was calculated by using the formula given by Singh *et al*. (1990)

$$SVI = \frac{\overline{Y} - \sigma}{Y\,max}$$

where,

$\overline{Y}$ Estimated average monetary values of economic produce over years

σ: Estimated standard deviation

Ymax: Observed maximum monetary value of economic produce

The data of yield, onion equivalent yield and economic in soybean-onion cropping sequence were recorded The data recorded on yield of crops in sequence cropping as influenced by different treatments were statistically analyses by techniques of analysis of variances (Fisher, 1958) and test of significance was carried out as given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

From the results of the experiment as shown above indicated that the application of organic fertilizer increased seed yield of soybean than control. Mishra *et al.* (1994) studied during *kharif* season to evaluate the soybean seed inoculation with *Rhizobium*, application of cycocel and 5 t FYM ha^{-1} alone and various combinations. They observed that integration of these factors obtained the highest seed yield (22.86 q ha^{-1}) compared with control yield (19.80 q ha^{-1}). Then, Rakesh and Singh (1996) reported that the highest seed yield of soybean was recorded with application of 100% NPK + FYM followed by that of 100% NPK + lime during *kharif* season. Jagdish *et al.* (1998) observed that combined application of FYM @ 15 t ha^{-1} + PSB inoculation recorded higher yield of soybean. Tumbare (2002) showed that application of 25 % N through straw of soybean + 75% NPK recommended dose increased the seed yield higher than the treatments with completed inorganic. In addition, Creamer *et al.* (2001) showed that conventional soybean yields were 47.2 q ha^{-1} while organic yields were 42.4 q ha^{-1}. Malik *et al.* (2006) also reported that *Rhizobium* inoculation, phosphorus @ 90 kg ha^{-1} with recommended application of N gave higher seed yield (1911.12 kg ha^{-1}) against control (1274.07 kg ha^{-1}).

The components yield, seed and straw yield of soybean was significantly influenced by different treatments of the experiment during both the years. The treatment T_7 of 100% NPK recommended dose was the highest in seed and straw yield followed by treatment of 50% N recommended as combined with 50% N though FYM. The application of chemical fertilizer responded to increase seed and straw yield of soybean. The registration in the seed and straw yield in treatments, in which organic sources was applied, recorded significantly higher both seed and straw yield compared with treatment control during both the years of the experimentation (**Table 1** and **2**). The yield over control was the higher in T_7 (145.1%) followed by T_1 (100.2%) applied with 50% N recommended + 50% N though FYM. The other treatments of organic fertilizers obtained 63.5 to 88.7% and 72.8 to 96.1% over control during first years and second, respectively.

Table 1. Yield and yield components of soybean as influenced by different treatments in *Kharif* seasons (2006-2007)

Treatment	2006-2007								
	Plant population ha^{-1}	Height plant (cm)	No. of pods /plant	Wt. of pod/ plant (g)	No. seeds /plant	Wt. of seed/ plant (g)	Wt. of 100 seeds (g)	Seed yield (q ha^{-1})	Yield over control (%)
T_1:50% NPK RDF + 50%N through FYM +Micronutrient as per soil test (Zn)	315555	46.30	45.8	22.99	109.5	16.80	13.68	23.42	100.2
T_2:1/3 N through each FYM, vermicompost and neem seed cake	316222	42.30	37.1	18.50	92.7	13.32	13.49	20.53	75.5
T_3: T_2 + Trap crop (Sannhemp)	316666	43.80	42.8	20.30	98.1	15.01	13.53	22.08	88.7
T_4: T_2 + Agronomic practices the hand weeding and IPM technique for pest control	317333	43.70	38.9	19.34	94.3	14.02	13.05	21.68	85.3
T_5: 50%N through FYM + *Rhizobium/ Azotobacter* + PSB	316000	44.55	36.9	18.75	95.7	13.60	13.13	19.72	68.5
T_6: T_2 + *Rhizobium/Azotobacter* + PSB	315777	43.20	41.1	21.59	98.6	15.36	13.33	21.51	83.8
T_7 : 100% NPK RDF	315111	50.75	47.1	24.47	115.2	17.49	13.71	28.68	145.1
T_8: Control (no fertilizer application)	315333	35.45	30.4	13.08	73.0	9.65	12.65	11.70	-
SE (m) ±	**579.8**	**1.39**	**1.19**	**0.90**	**4.33**	**0.66**	**0.28**	**0.43**	-
CD at 5%	**N.S**	**4.11**	**3.53**	**2.67**	**12.82**	**1.97**	**NS**	**1.29**	
General mean	**316000**	**43.75**	**40.01**	**19.87**	**97.13**	**14.40**	**13.32**	**21.16**	-

Bhujbal (1989) recorded that the effect of organic, inorganic and biofertilizer on growth, yield and storage quality of bulbs c*v.* N-2-4-1, reported that the highest plant height and number of leaves per plant were recorded by the treatment of 60 t FYM + 100:50:50 kg NPK ha^{-1}. With Francuk and Jablońska-Ceglarek (2002) reported the kinds of organic fertilization applied in the experiment had a significant effect on increasing the yield of onion as compared to without organic fertilization. The yield of onion increased respectively by 22.76 - 59.70 per cent and 17.30 - 48.65 per cent. In addition, Abbey and Kanton (2003) revealed from the application of farmyard manure (FYM), inorganic fertilizer (IF) or a combination of manure and inorganic fertilizer (FYM + IF) that the onion bulb weight was increased by FYM+IF in both the years. Similarly, Morarka (2006) reported

that the application of dose of about 2500 kg of vermicast ha^{-1} to onion has been recommended as a substitute for chemical fertilizers. The use of farmyard manure also had been reduced to 50 percent level of chemical fertilizer. The results showed that the plant population was not significant at harvest of both years of onion. The maximum height plant, dry matter plant^{-1}, fresh weight of single bulb, leaves, bulb yield of onion and onion equivalent yield in treatment T_7 of 100% NPK recommended dose was found significantly higher than other treatments followed by treatment T_1 of 50% NPK recommended dose combined with 50% N through FYM while the minimum was reported in treatment control during both the years of the experimentation. The per cent of pooled mean over control of onion bulb yield was the highest in 100% NPK recommended dose (97.1%) and the other treatments of organic were also higher as compared with control and obtained 39.2 to 49.4 per cent (**Table 3** and **4**).

Table 2. Yield and yield components of soybean as influenced by different treatments in *Kharif* seasons (2007-2008)

Treatment	2007-2008								
	Plant population ha^{-1}	Height plant (cm)	No. of pods /plant	Wt. of pod/ plant (g)	No. seeds /plant	Wt. of seed/ plant (g)	Wt. of 100 seeds (g)	Seed yield (q ha^{-1})	Yield over control (%)
T_1:50% NPK RDF + 50%N through FYM + Micronutrient as per soil test (Zn)	315778	50.35	51.5	23.12	123.0	17.02	13.50	24.14	106.3
T_2:1/3 N through each FYM, vermicompost and neem seed cake	316667	41.35	43.6	19.80	100.4	13.95	13.56	20.81	77.9
T_3: T_2 + Trap crop (Sannhemp)	316444	44.40	51.0	20.79	113.1	15.45	13.60	22.54	92.6
T_4: T_2 + Agronomic practices the hand weeding and IPM technique for pest control	316222	45.65	48.1	20.79	106.4	14.80	13.61	22.13	89.1
T_5: 50%N through FYM + *Rhizobium/ Azotobacter* + PSB	316222	44.80	48.0	19.12	96.8	13.71	13.68	20.33	73.8
T_6:T_2 + *Rhizobium/Azotobacter* + PSB	315333	47.60	49.8	21.63	112.3	15.76	13.58	22.94	96.1
T_7 : 100% NPK RDF	315778	54.05	56.0	25.87	134.3	18.40	13.83	29.62	153.2
T_8: Control (no fertilizer application)	315778	36.05	38.4	13.20	74.1	9.24	13.39	12.30	-
SE (m) ±	695.29	2.15	1.75	0.69	4.59	0.45	0.18	0.38	-
CD at 5%	NS	6.38	5.18	2.06	13.60	1.35	NS	1.12	
General mean	316028	45.53	48.30	20.54	107.53	14.79	13.59	21.86	-

Table 3. Plant population ha^{-1}, height plant (cm), dry matter plant^{-1}, fresh weight of single bulb, leaves and bulb yield of onion influence different treatments in *rabi* season (2006-07 and 2007-08).

Treatment	2006-2007						2007-2008					
	Plant population ha^{-1}	Height plant (cm)	Dry matter (g)	Wt. fresh/ bulb (g)	Leaves yield (q ha^{-1})	Bulb yield (q ha^{-1})	Plant population ha^{-1}	Height plant (cm)	Dry matter (g)	Wt. fresh/ bulb (g)	Leaves yield (q ha^{-1})	Bulb yield (q ha^{-1})
T_1:50% NPK RDF + 50%N through FYM + Micronutrient as per soil test (Zn)	653932	41.4	17.91	69.7	11.7	235.3	651207	49.5	22.16	74.8	12.0	243.4
T_2:1/3 N through each FYM, vermicompost and neem seed cake	654307	40.5	14.45	58.7	11.1	221.4	648792	43.0	18.23	62.2	11.0	227.3
T_3: T_2 + Trap crop (Sannhemp)	652808	41.1	15.65	63.5	11.0	222.3	648792	43.1	19.97	68.7	11.8	229.9
T_4: T_2 + Agronomic practices the hand weeding and IPM technique for pest control	652808	43.6	15.59	62.2	11.0	224.3	648309	42.7	19.65	67.6	12.1	231.2
T_5: 50%N through FYM + *Rhizobium/ Azotobacter* + PSB	652434	40.3	16.00	60.1	10.3	210.3	649275	42.8	19.26	62.1	10.9	217.1
T_6: T_2 + *Rhizobium/ Azotobacter* + PSB	653558	43.5	15.22	63.6	11.5	225.6	649275	45.2	21.24	66.7	11.4	233.3
T_7 : 100% NPK RDF	652809	39.5	18.13	78.4	15.5	298.3	650241	52.0	26.33	84.7	15.9	307.2
T_8: Control (no fertilizer application)	653932	40.7	11.84	43.0	7.2	150.4	643961	38.4	14.98	45.5	7.6	156.6
SE (m) ±	**944**	**1.39**	**0.43**	**3.02**	**0.41**	**3.68**	**1504**	**0.86**	**0.94**	**2.39**	**0.51**	**3.24**
CD at 5%	**NS**	**NS**	**1.29**	**8.95**	**1.23**	**12.16**	**NS**	**2.56**	**2.79**	**7.07**	**1.52**	**9.61**
General mean	**653323**	**41.3**	**15.60**	**62.4**	**11.1**	**223.4**	**648732**	**44.6**	**20.23**	**66.5**	**11.6**	**230.8**

Table 4. Pooled mean of leaves and bulb yield, bulb yield over control and onion equivalent yield as influenced by different treatments (q ha^{-1}).

Treatment	Pooled mean			Onion equivalent yield (q ha-1)		
	Leaves (q ha^{-1})	Bulb yield (q ha^{-1})	Yield over control (%)	*Rabi* 2006-2007	*Rabi* 2007-2008	Pooled mean basis
T_1:50% NPK RDF + 50%N through FYM + Micronutrient as per soil test (Zn)	11.8	239.4	55.8	297.07	321.47	309.27
T_2:1/3 N through each FYM, vermicompost and neem seed cake	11.0	224.4	46.1	276.86	294.60	285.73
T_3: T_2 + Trap crop (Sannhemp)	11.4	226.1	47.2	281.18	302.80	291.99
T_4: T_2 + Agronomic practices the hand weeding and IPM technique for pest control.	11.5	227.8	48.3	280.54	302.82	291.68
T_5: 50%N through FYM + *Rhizobium/ Azotobacter* + PSB	10.6	213.7	39.2	262.91	282.93	272.92
T_6: T_2 + *Rhizobium/Azotobacter* + PSB	11.4	229.5	49.4	283.00	307.57	295.28
T_7 : 100% NPK RDF	15.7	302.8	97.1	374.97	403.00	388.98
T_8: Control (no fertilizer application)	7.4	153.5	-	178.88	196.43	187.65
SE (m) ±	0.25	2.52		4.16	3.68	2.53
CD at 5%	0.75	7.46		12.34	10.90	7.51
General mean	11.38	227.2		279.43	301.45	290.44

The soybean based cropping sequence was found with high monetary benefit, as reported by Chatterjee and Roquib (1975), Bharambe *et al.* (1990), Bhatia (1995) and Tumbare (2002). The results of pooled mean net monetary returns, B:C ratio and SVI in different treatments revealed that the pooled mean net monetary returns (Rs 148971 ha^{-1}), with B:C ratio (2.87) and SVI (0.78) were at higher magnitude when crop was applied 100% NPK recommended dose followed by 50% NPK recommended dose combined with 50% N through FYM with Rs 99759 ha^{-1}, B:C ratio 2.21 and SVI (0.45) (**Table 5**). The other treatments organic sources were applied, were found higher in net monetary returns (Rs 67458 - 80819), B:C ratio (1.67 – 2.01) and SVI (0.24 – 0.33) than treatment control (net monetary returns, B:C ratio and SVI with Rs 37395, 1.51 and 0.03, respectively).

Table 5. Pooled mean of Economics and sustainable value index (SVI) in soybean-onion crop sequence as influenced by different treatments after two cycles of soybean –onion cropping sequence.

Treatment	2006-2008				SVI
	Gross monetary returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net monetary returns (Rs ha^{-1})	B:C ratio	
T_1:50% NPK RDF + 50%N through FYM + micronutrient as per soil test (Zn)	181914	82155	99759	2.21	0.45
T_2:1/3 N through each FYM, vermicompost and neem seed cake	167751	100292	67458	1.67	0.24
T_3: T_2 + Trap crop (Sannhemp)	171573	99792	71780	1.71	0.27
T_4: T_2 + Agronomic practices hand weeding and IPM for pest control	171879	100892	70986	1.70	0.26
T_5: 50%N through FYM + *Rhizobium/Azotobacter* + PSB	160382	79562	80819	2.01	0.33
T_6: T_2 + *Rhizobium/Azotobacter* + PSB	173448	100292	73155	1.72	0.27
T_7 : 100% NPK RDF	228245	79274	148971	2.87	0.78
T_8: Control (no fertilizer application)	110340	72945	37395	1.51	0.03
SE (m) ±	1399.3	-	1399.3	0.01	–
LSD at 5%	4143.1		4143.1	0.04	
General mean	170691	89401	81290	1.92	0.32

**Price : - Soybean Rs1600 and 1875 per quintal during 2006 and 2007, respectively.*
- Soybean straw Rs 50 and 40 per quintal during during 2006 and 2007, respectively
- Leaves of onion Rs 20 and 13 per quintal during 2006 and 2007, respectively
- Bulb of onion Rs 600 and 587 per quintal during 2006 and 2007, respectively.
- Rs (rupees) 48 = $ 1 US

CONCLUSION

- The production potential of soybean-onion cropping sequence was highest in the organic treatment of application of 100% N through FYM, vermicompost, neem seed cake and *Rhizobium/Azotobacter* + PSB (295.5 q of onion equivalent yield ha^{-1}).
- The total maximum net monetary returns (Rs 148971 ha^{-1}) and higher B:C ratio (2.87) and sustainable value index (0.78) was found in 100 percent recommended dose of fertilizer ($N:P_2O_5:K_2O$ with 50:75:00 kg ha^{-1} for soybean and 100:50:50 kg ha^{-1} for onion).
- Application of 100% organic nutrient source through FYM, vermicompost, neem seed cake, *Rhizobium/Azotobacter,* PSB and trap crops gave higher yield, net monetary returns as compared with control.

RECOMMENDED:

- Soybean-onion cropping sequence with 100 percent recommended dose of fertilizer ($N:P_2O_5:K_2O$ with 50:75:00 kg ha^{-1} for soybean and 100:50:50 kg ha^{-1} for onion) was found economically profitable.

REFERENCES

Abbey L and RAL Kanton. 2003. Fertilizer type, but not time of cessation of irrigation, affect onion development and yield in a semiarid region. *J.Veg. Crop Proc. Vol. 9 (2): 41-48.*

Bharambe PR, VD Sondge, RP Rodge, SR Oza. 1990. Performance of different crop sequence under various levels of irrigation in vertisols. *Indian J. Agric. Sci. 60. pp: 402-405*.

Bhatia AK. 1995. Statistical evaluation of crop sequence. *Ann. Agric. Res. 16 (2):184-187*.

Bhujbal PK. 1989. Effect of organic, inorganic and biofertilizers on growth, yield and storage

quality of onion bulbs cv. N-2-4-1. M.Sc.Thesis submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India.

Chatterjee BN and MA Roquib. 1975. Soybean in multiple cropping and intercrooping. *Indian J. Gen. and plant breed. 35(2):264-268*

Fisher RA. 1958. Statistical methods for research workers. 13th edition Oliver and Bayal, Edinburg.

Franczuk J and CR Jabłońska CR. 2002. Fertilization with green fertilizers from papilionaceous plants and with straw in relation to the yielding of vegetables. *Electronic J. Polish Agri. Uni., Hort., Vol. 5(2).* Available online: http://www.ejpau.media.pl/series/ volume5/ issue2 /horticulture/art-07.html

Haldankar CB, VM Raut, SP Taware, VP Patil. 1992. Production component study in soybean. *J. Maharashtra Agric. Univ. 17(3): 396-398.*

Jagadish P, PN Hajare, DK Mandal. 1998. Effect of P solubilizers on soybean grain yield in swelling clay soils. *J. Indian Soc. Soil Sci. 46(3): 468-469.*

Malik MA, MA Cheema, HZ Khan, MA Wahid. 2006. Growth and yield response of soybean (*glycine max* L.) to seed inoculation and varying phosphorus levels. *J. Agri. Res. 44(1): 47-53.*

Mishra OR, SC Kondlia, RA Sharma. 1994. Influence of fertility levels, cycocel, *Rhizobium* culture and FYM on growth and yield of soybean. *Crop Res. 7(1):156-158.*

Morarka MR. 2006. Vermicast application in agriculture. M. R. Morarka-GDC Rural Research Foundation, Rajasthan India. All Rights Reserved. Web solutions from http:// www.cyberparkonline.com/

Phadke A. 2001. Problems and Prospects of Biofertilizer Use. Paper presented at National Seminar on Bio-fertilizers and micro-nutrients at Vigyan Bhavan, New Delhi, February 8, 2001.

Rakesh K, KP Singh. 1996. Long term effects of fertilizer lime and FYM on yield, nutrient uptake by soybean and soil properties. *J. Res. BAU. 8(2):115-118.*

Scholten O and VA van Bruggen. 2007. Improved disease resistance in onion through introgression of disease resistance by the use of wild relatives and the effect of arbuscular mycorrhiza fungi. Wageningen University, England.

Singh RP, SK Das, UM Bhaskarao, N Reddy. 1990. Toward sustainable dryland agricultural practices. pp.1-9.

Tumbare AD. 2002. Integrated nutrient management in soybean-onion cropping sequence. Ph.D. Thesis submitted to Dept. of Agronomy, M.P.K.V., Rahuri, Dist. Ahmednagar, Maharashtra.

Wiederholt R, D Franzen, B Johnson. 2005. Livestock manure utilization in no-till cropping systems. North Dakota State University Agriculture and University Extension. North Dakota, USA. Online: http://www.ag.ndsu.edu/pubs/ ansci/waste/nm1292w.htm/

Đánh gía quản lý dinh dưỡng tổng hợp đối với áp dụng hữu cơ trên hệ thống luân canh đậu nành – hành củ.

Kết quả nghiên cứu sau hai năm (2006-2008) trên hệ thống luân canh đậu nành-hành củ đã cho thấy nghiệm thức áp dụng 100% NPK đã cho năng suất hạt của đậu nành, củ hành và năng suất qui đổi ra củ hành có sự khác biệt ý nghĩa thống kê cao hơn so với các nghiệm thức khác. Tiếp theo sau là nghiệm thức áp dụng 50% NPK kết hợp với 50% N nhờ vào phân hữu cơ FYM. Tất cả các nghiệm thức được áp dụng nguồn hữu cơ đã có sự gia tăng khác biệt có nghĩa thống kê so với đối chứng về các thành phần năng suất này. Trung bình hiệu quả kinh tế qua hai năm cũng cho thấy nghiệm thức áp dụng 100% NPK đạt lãi ròng là 148,971 rupees, tỉ lệ B:C là 2.87 và hệ số bền vững SVI đạt 0.78. Các nghiệm thức được áp dụng hòan tòan nguồn hữu cơ cũng đã cho thấy khác biệt có ý nghĩa thống kê cao hơn so với đối chứng về các hiệu quả kinh tế này (lãi thuần, tỉ lệ B:C và chỉ số bền vững SVI).