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Short Communication

EFFECT OF USING VARYING LEVEL OF NPK AND BIOFERTILIZERS ON VEGETATIVE GROWTH AND YIELD OF OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH)

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Indiscriminate use of inorganic fertilizers and pesticides has caused health hazards to human, besides deteriorating the soil, groundwater and environment ecology. Biofertilizers holds a vast potential for supply of major plant nutrients like nitrogen and phosphorus more economically. However, biofertilizers if supplement with the chemical fertilizer they can reduce the need of chemical fertilizers by 25-50%. Thus, there is need to integrate and balance supply of chemical fertilizers, organic manures and biofertilizers for sustaining productivity and soil health and also supplementing a part of chemical fertilizer requirement through these resources. There are considerable scientific data, which shows that combined application of chemical fertilizer and biofertilizers increase yield and influence quality attributes in several vegetables, besides saving of chemical fertilizers (Shankaranarayaan *et al*., 1995; Verma *et al*., 1997; Bahadur and Manohar, 2001, Bahadur *et al.,* 2003).

A field experiment on okra cv. VRO-6 (Kashi Pragati) was carried out at IIVR, Varanasi. The soil of experimental plot was sandy loam, Typic Utochrept, Inceptisol. Important chemical properties of the soil are: pH 7.2, organic carbon 0.39%, EC 0.32 dSm^{-1}, available N, P and K are 258, 20.5 and 185 kg ha^{-1}, respectively. The treatments comprised of three different dose of N or P (50%, 75% and 100% of recommended dose) in combination with three biofertilizers, namely, VAM, *Azospirillum* and Phosphate solubilizing microorganisms (PSM). Thus, a total of 10 treatments including control (recommended NPK @ 100:50:50 kg/ha) were replicated thrice in RBD arrangement. Calculated amount of full dose of P and K and half dose of calculated N were applied at sowing, whereas rest amount of N was supplied at 35 days after sowing. Besides, FYM @ 10 t/ha was applied during final field preparation.

Pre-imbibed seeds of okra were inoculated in thick slurry of biofertilizers @ 100g/100g seed during sowing. Two seeds at one place were sown on raised bed at 50 x 35 cm, later on after 7 days of sowing plants were thinned out or gap filled to maintained desired spacing. Yield and yield attributing parameters were recorded and analyzed statiscally.

Table 1. Effect of inorganic manures and biofertilizers on vegetative growth of okra

Treatment	Plant height (cm)	No. of leaves/ plant	Leaf length (cm)	Leaf width (cm)	No. of nodes /plant	Internodal length (cm)
V1 = 50% P and full dose of NK + VA-Mycorrhizae	18.58	9.67	9.10	10.8	16.3	1.82
V2 = 75% P and full dose of NK + VA-Mycorrhizae	19.82	12.67	9.67	13.6	17.7	1.93
V3 = Rec. NPK + VA-Mycorrhizae	19.32	10.00	10.20	13.3	16.7	1.97
A1 = 50% N and full dose of PK + Azospirillum	19.15	10.33	10.17	12.3	18.0	1.94
A2 = 75% N and full dose of PK + Azospirillum	20.05	10.00	9.97	13.5	19.0	2.09
A3 = Rec. NPK + Azospirillum	21.50	11.33	10.10	12.4	18.7	2.13
P1 = 50% N and full dose of PK + PSM	20.91	10.00	11.27	14.5	19.3	1.90
P2 = 75% N and full dose of PK + PSM	23.39	10.33	11.17	14.0	20.3	2.16
P3 = Rec. NPK + PSM	20.55	12.33	10.50	13.3	17.3	1.83
Control (Rec. NPK; 100: 50:50 kg/ha)	17.17	10.67	9.77	12.7	16.3	1.49
SEm $\pm$	0.95	0.44	0.41	0.36	0.71	0.12
LSD	2.81	1.32	1.21	1.07	2.11	0.36

Table 2. Effect of inorganic manures and biofertilizers on yield attributes of okra

Treatment	No. of pods/ plant	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Pod yield (kg /plant)	Pod yield (q/ha)
V1 = 50% N and full dose of PK + VAM	14.7	13.5	1.45	17.53	313.99	122.26
V2 = 75% N and full dose of PK + VAM	16.0	13.7	1.97	20.73	344.38	131.03
V3 = Rec. NPK + VAM	15.7	14.0	1.93	21.43	348.29	139.51
A1 = 50% N and full dose of PK + Azospirillum	16.7	13.3	1.57	19.60	320.32	129.17
A2 = 75% N and full dose of PK + Azospirillum	17.3	14.4	2.20	22.01	346.92	134.50
A3 = Rec. NPK + *Azospirillum*	17.3	14.9	1.97	23.09	379.66	150.86
P1 = 50% P and full dose of NK + Phosphate solubilizers	17.0	14.6	1.67	22.87	390.85	149.34
P2 = 75% P and full dose of NK + Phosphate solubilizers	19.0	15.1	1.67	23.12	396.35	160.87
P3 = Rec. NPK + Phosphate solubilizers	16.0	13.5	1.90	20.76	334.15	129.66
Rec. NPK (100:50:50 kg/ha)	15.7	13.3	1.74	20.43	323.95	124.38
SEm $\pm$	0.62	0.38	0.17	0.79	8.87	5.77
LSD	1.83	1.11	NS	2.35	26.36	17.33

Significantly higher plant height over control was recorded under A2, A3, P1, P2 and P3; whereas the higher number of leaves/plant was registered under V2 (12.67) and P3 (12.33). Significantly higher leaf length and width was noticed when seeds were inoculated with phosphate solubilizers and plant was supplicated with 50% P (P1) or 75% P (P2). The maximum number of nodes/plant was observed under A2, A3, P1 and P2, whereas significantly higher internodal length was recorded under in all treatments, except V1 and P3.

The maximum number of pods (19.0 $\pm$ 0.62/plant) was registered in treatment comprising 75% P and full amount of NK + seed inoculation in phosphate solubilizers. Significantly higher pod length over rec. NPK was observed in A2, A3, P1 and P2. Combined application of biofertilizers and chemical fertilizers did not affect the pod diameter in okra. In present study, remarkably and significantly higher pod weight and green pod yield was noticed under A3, P1 and P2 (table 2). These treatments registered an increase of 21.3%, 20.1% and 29.3% higher pod yield, respectively over recommended NPK.

The improvement in growth and yield attributes due to phosphate solubilizers may be because of the ability of PSM to solubilize and increase availability of inorganic phosphorus from insoluble or otherwise fixed P to soluble or readily plant available P (Verma and Mathur, 1989; Sunderarao and Sinha, 1963). Thus, PSM inoculation under our study might have enhanced the availability of macronutrient, particularly P result in significant influence on above parameters. Besides, they are also known to produce amino acids, vitamins, growth promoting substances like IAA and GA which help in better growth and yield. Earlier, Shankaranarayanan *et al*. (1995) and Bahadur and Manohar (2001) in okra also noticed an increased yield with *Azospirillum* inoculation.

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