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Effect of NPK Rhizobium and PSB on Growth and Nodulation of Pea (*Pisum sativum* L.)

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ABSTRACT

An experiment was conducted during Rabi season of 2017-18. Seedlings of pea variety kashi Uday were raised with normal Package of Practices effect of two NPK levels i.e (30:60:30 and 40:80:30 kg^{-1}ha) along with biofertilizers i.e Rhizobium and Phosphorous Solublising Bacteria (PSB) were studied on plant growth and nodulation. The treatment combination of NPK (30:60:30 kg^{-1}ha) + Rhizobium + PSB was found to be the best pertaining to growth and nodulation.

Key words: *Biofertilizers, PSB, NPK, Rhizobium*

INTRODUCTION

Pea is one of the important vegetable crops of the world cultivated over an area of 7625 thousand hectares with a production of 11535 metric tonnes while India has an area of 305.20 thousand hectare with a production of 2061.80 thousand metric tonnes. In Bihar it is cultivated throughout the state in area of 23.3 thousand hectare having production of 139.6 thousand metric tonnes.. It is well established that use of chemical fertilizers do improve productivity but widespread us of these chemical fertilizers leads to degradation of soil quality and low productivity in the long run. So, to maintain a balance between productivity and fertility of soil, a judicious mixture of chemical and biofertilizers should be encouraged.

Micro organisms induce many biochemical transformations in the soil these include mineralization of organically bound form of nutrients. These exchange reactions fixation of atmospheric nitrogen and various other changes leading to better availability of nutrients already present in the soil. The group of micro-organisms responsible for nitrogen fixation phosphorous solublisation and compost decomposition are being put to beneficial use in the form of biofertilizers. Significant development in the production and distribution of biofertilizer are taking place in India. At present, the major emphasis is on inoculants of Rhizobium followed buy Azosirillum, Blue, Green Alage and Azotobacter.

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The National Biofertilizer Development center established by the government of India is the nodal agency for planning co-ordination, monitoring the quality control of biofertilizer. Biofertilizers show good results as growth and yield of a crop as the influence is subject to various environmental factors once introduced into the soil so the effect of biofertilizer on crop growth and yield is not as striking as that of chemical fertilizer, The present was under taken to see the effect of nitrogen, Phosphorous, Potassium, Rhizobium and PSB on nodulation of Pea.

MATERIAL AND METHODS

The experiment was conducted under field conditions during rabi season of 2017-18 at kvk research farm of KVK Aurangabad. The pea variety kasha uday was selected for the experiment soil type was sandy loam with well drained sub-soil having pH 5-6 organic carbon .57% Nitrogen128 kg ha^{-1}. The seed were sown on december 11, 2017 in the sub plots having a size of 4.20 m X 2.50 with the planting distance of 30cm x 10 cm inclines and covered with a thin layer of mixture of soil and compost two forms of NPK (40:80:40 and 30:60:30 kg ha^{-1}) along with Rhizobium and along with Rhizobium and PSB was applied as a treatment. The experiment was laid out under RBD design with 11 treatments and 3 replications. The observations on nodulation were recorded on five sample plants from each treatment.

RESULTS AND DISCUSSION

Germination: The perusal of the data presented in the table revealed that the days taken in more than 50% germination were significantly influenced by different treatments. Minimum 10:30 days were taken in treatment T_{10}, T_9 and T_4. Maximum days 11:33 were recorded in control which was at par with treatments T_3, T_5, T_7 and T_8. with values 11.3, 11.5, 11.00 and 11.33 days respectively.

Plant height: At 60 days after sowing, maximum height 53.39 cm was recorded in treatment T_{10} closely followed by T_9 (51.36 cm) where as minimum height (31.70 cm) was recorded as in control To, Treatments T_8, T_7, T_6 and T_1 were statistically at par with values 48.74, 46.25, 45.28 and 44.70 cm respectively and maximum number of leaves per plant was observed in treatment, T_{10}, (51.56) which was at par with treatments, T_9, (47.36) and T_8, (45.50). The treatments T_7, T_6, T_5, T_4, & T_1, with values 44.90, 42.10, 40.96, 38.63 and 42.36 leaves per plant respectively were at par but superior to control (30.66).

***Flowering*:** Days to more than 50% flowering was significantly influenced by different treatments. Minimum day taken in more than 50% flowering i.e. 41.33 were recorded in treatment T_{10}, which was at par with T_9, T_8, and T_7 with values 41.66, 42.66, and 43.00 days, respectively. These treatments were superior to rest of the other treatments including the control (53.00 days). The treatments T_1, and T_0 were at par with each other with values 44.33 and 46.00 days, respectively.

Nodules: The highest number of nodules (30.26) were recorded in treatment T_{10}, (NPK 30:60:30 + Rhizobium + PSB) then followed by treatment T_9 with value 23.06 nodules per plant the treatments T_5 and T_7 with value 17.50 and 18.07 nodules per plant were superior to the control (8.53 $nodules^{-1}$plant). Significantly highest fresh weight of nodules was recorded in treatment T0 (63.96 mg). The treatment T9 (57.33 mg) was also superior to rest of the other treatment with values 57.33 mg. Treatments T_8, T_7 and T_6 were at par among themselves with values 50.70, 48.56 and 49.63 mg, respectively. The treatments T_5, T_4 and T_3 were at par with values 43.33, 41.36 and 39.86 mg respectively but superior to the control (32.30 mg) T_2 (32.06 mg) and T_1 (34.76 mg). Highest dry wt of nodules per plant was observed in treatment T_{10} (14.08 mg) which was closely followed by treatments T_9, T_8 and T_7 with values 13.65, 13.17 and 12.39 mg, respectively. The treatment T_6, T_5 and T_4 were at par among themselves with values 11.24, 10.89 and 10.04 mg but significant to the control (7.40 mg).the treatments T_3 (8.87 mg) and T_2 (7.69 mg) were also superior to the

control but at par with each other. The treatment T_1 has less value (6.44 mg) than control (7.40 mg) but statistically at par with control.

The superiority of the treatment T_{10} (NPK 30:60:30 kg^{-1}ha + Rhizobium + PSB) is attributed to several physical and biochemical factors such as phosphorus increases nodulation bacteria require phosphorus for growth and development. Kanujia *et al*.[2], obtained increase in number of nodulation, fresh and dry weight of nodules due to application of phosphorus. At high concentration of nitrogen (NO_3^-, NH_4^+) suppress nif genes in bacteria resulting in less synthesis of nitrogenase enzyme, which adversely affect nitrification.

Seed treated with rhizobium increased vegetative growth and nodulation in comparison to control. Rhizobium is a symbiotic micro-organism which forms root nodules in legumes through symbiosis. In these nodules bacteria converts molecular form of nitrogen into available form of nitrogen. The Rhizobium – Legume associated could fix up to 40-200 kg nitrogen $ha^{-1}season^{-1}$ and is able to meet up to 80-90% of the crop nitrogen needs[1]. Legume inoculants, seed treatment with Rhizobium generally register a 20 to 40% increase in production depending on crop and climatic conditions Singh *et al*.[4], The favorable effect may be due the fact that Rhizobium inoculation increased nitrogenase activity and also synthesis of growth promoting substances like to indole acetic acid which take part in nodulation process and also influence vegetative growth. Thus increase in nodulation, nitrogen fixation and synthesis of growth substances might have increase vegetative growth, yield attributing characters similar results also reported by Prasad and Prasad[3]. Thus, on the basis of experimental findings, it might be concluded that among the various combinations of chemical fertilizer and biofertilizers treatment T_{10} (NPK 30:60:30 kg^{-1}ha + Rhizobium + PSB) proved best in respect of growth, nodulation of pea (*Pisum sativum* L.).

Stability parameters of different characters in pea

Treatments	Days taken in >50 germination (nos.)	Plant height 60 days (cm)	No. of leaves 60 days. (nos.)	Days taken in 50% flowering (days)	No. of nodules plant (nos.)	Fresh weight of nodules (gm)	Dry weight of nodules (gm)
Control	11.33	31.70	30.66	53.00	8.53	32.30	7.40
NPK 40:80:40	10.66	44.70	42.36	44.33	9.66	34.76	6.44
NPK 30:60:30	10.66	33.46	32.20	50.33	10.12	35.06	7.69
Rhizobium	11.33	35.80	34.16	48.66	14.26	39.86	8.87
PSB	10.33	37.86	38.63	48.33	15.13	41.36	10.04
T_1+T_3	11.15	41.43	40.96	47.33	17.50	43.33	10.89
T_2+T_3	10.00	45.28	42.10	46.00	21.05	49.63	11.24
T_1+T_4	11.00	46.25	44.90	43.00	18.07	48.56	12.39
T_2+T_4	11.33	48.74	45.50	42.66	20.31	50.70	13.17
T_1+T_3+T_4	10.33	51.36	47.36	41.66	23.06	57.33	13.65
T_2+T_3+T_4	10.33	53.39	51.56	41.33	30.26	63.96	14.08
S E (m)	0.18	1.57	2.15	0.73	0.56	1.33	0.82
CD1 at 5%	0.53	4.63	6.36	2.15	1.67	3.94	2.43
CD2at 1%	0.39	3.40	4.67	1.59	1.23	2.95	1.79
CV	0.26	.058	0.83	0.67	0.52	0.46	1.23

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