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Response of Foliar and Soil Application of Phosphatic Fertilizer on Growth and Yield of Soybean

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ABSTRACT: *The field investigation was conducted during the* kharif *season of 2012 at the experimental farm, Department of Agronomy, College of Agriculture, M.K.V., Parbhani with a view to find out the response of foliar and soil application of phosphatic fertilizer on growth and yield of soybean. The experiment was laid out in FRBD design with twelve treatment combinations, comprising of three phosphorus levels viz.* P_1 *(0 kg* P_2O_2 ha^{-1}*),* P_2 *(30 kg* P_2O_2 ha^{-1}*) and* P_3 *(60 kg* P_2O_2 ha^{-1}*) and four foliar sprays of BOOST-52 (0:52:34) viz.,* F_0 *(no foliar application),* F_1 *(foliar application of BOOST-52 (0:52:34) at 35 DAS),* F_2 *(foliar application of BOOST-52 at 50 DAS) and* F_3 *(foliar application of BOOST-52 (0:52:34) at 35 DAS and 50 DAS). From the result of experiment it can be concluded that among the phosphorus level* P_3 *(60 kg* P_2O_2 ha^{-1}*) and foliar application of BOOST -52 (0:52:34) at 35 and 50 DAS (*F_3*) were the best with better growth, yield and profitable also.*

Key words: *Soybean, foliar and soil application of phosphatic fertilizer*

Soybean crop tolerate long dry spell, cost of crop production is less and being a leguminous crop capable of fixing atmospheric nitrogen to an extent of 65 to 100 kg ha^{-1} to improve the soil fertility through the nodules and therefore it requires less nitrogen (Nagaraju and Mohankumr). Soybean is miracle golden bean of 21st century which posses potential to revolutionized Indian economy by correcting the health of human being.

Soybean removes large quantity of phosphorus, potash and sulphur from soil. Phosphorus is one of the major essential plant nutrients and without its adequate supply the plant can neither reach its yield potential nor can complete its normal reproductive process. It plays an important role in the translocation of sugar, germination of seeds, early root development and establishment of seedling. It also aids in early maturity of plant and counteracts the effects of excess nitrogen.

In most of the soil the status of available phosphorus is very low. Therefore available phosphorus level must be supplemented by adding chemical fertilizer but unfortunately most of the phosphorus supplied is converted into less available forms. Phosphorus availability in vertisol is limited due to fixation of phosphorus by the dominant clay particle i.e. montmorillonite. Many investigations revealed that crop utilize only 15- 20 per cent of applied phosphorus and rest is retained in the form which is not readily available to the crop. Imbalanced nutrient application by farmer is the most important factor limiting the productivity of soybean. In addition to this, low phosphorus status combined with the sub optional use of phosphorus is also responsible for low productivity. Optimum dose of phosphorus fertilizer is very important in increasing the yield of soybean. Phosphorus can be applied both as soil application and foliar application. The optimum level and method of application will be helpful for high phosphorus use efficiency, and will prove economically remunerative to the farmers.

Taking into consideration the above fact, present investigation was undertaken with an objective to find out response of foliar and soil application of phosphatic fertilizer on growth and yield of soybean.

MATERIALS AND METHODS

The field experiment was conducted at Department of Agronomy, College of Agriculture, Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* 2012. The experiment was laid out in FRBD design with twelve treatment combinations, comprising of three

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phosphorus levels viz. P_1 (0 kg P_2O_2 ha^{-1}), P_2 (30 kg P_2O_2 ha^{-1}) and P_3 (60 kg P_2O_2 ha^{-1}) and four foliar sprays of BOOST-52 (0:52:34) viz., F_0 (no foliar application), F_1 (foliar application of BOOST-52 (0:52:34) at 35 DAS), F_2 (foliar application of BOOST-52 at 50 DAS) and F_3 (foliar application of BOOST-52 (0:52:34) at 35 DAS and 50 DAS). 30 kg N ha^{-1} as basal application and 1.25 kg K_2O ha^{-1} as foliar application at 35 and 50 DAS were common for all the treatments. Gross and net plot size was, 5.4 m x 4.5 m and 4.5 m x 4.0m, respectively. The soil was clayey in texture, low in organic carbon, poor in nitrogen and medium in available phosphorus and high in potash and slightly alkaline reaction. Sowing was done by dibbling on 7th July, 2012. The genotype used for study was MAUS-71.The recommended schedule of plant protection was followed.

RESULTS AND DISCUSSION

Effect of phosphorus levels and foliar application of BOOST-52 (0:52:34) on different growth and yield parameters of soybean was significant, the is data presented in Table 1,2 3 and 4.

Effect of phosphorus levels

Phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) recorded significantly maximum plant height over phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) and at par with Phosphorus level P_2 (30 kg P_2O_5 ha^{-1}) similar trend was observed in case of number of functional leaves per plant, leaf area, number of branches and drymatter per plant. Phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) recorded lowest number of functional leaves per plant, leaf area and number of branches and drymatter per plant. Similar results were reported by Gosavi *et al* (2008) and Atheek *et al* (2006).

The data revealed that the effect of phosphorus levels on mean number of pods per plant was found significant. Phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) recorded significantly more number of pods per plant over phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) but it was at par with Phosphorus level P_2 (30 kg P_2O_5 ha^{-1}). Phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) recorded significantly higher seed weight per plant over phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) and it was at par with phosphorus level P_2 (30 kg P_2O_5 ha^{-1}). Similar kind of trend was observed regarding number of seeds per plant. The effect of phosphorus levels on 1000 seed weight was found to be non significant. Similar results were reported by Vara *et al* (1994) and Gautam *et al* (2003).

Seed yield differed significantly at phosphorus levels. The phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) recorded significantly high seed yield (2393 kg ha^{-1}) over phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) and it was at par with P_2 (30 kg P_2O_5 ha^{-1}). The lowest seed yield (1671.2 kg ha^{-1}) was obtained at phosphorus level P_1 (0 kg P_2O_5 ha^{-1}). Similar trend was observed in case of straw and biological yield. Seed yield is a function of yield attributing characters, hence the increase in seed yield with phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) resulted due to increase in yield attributes like weight of pods and seed weight per plant, number of seeds per plant. Similar results were reported by Sarawagi and Rajput (2005).

Among the phosphorus levels, P_2 (30 kg P_2O_5 ha^{-1}) recorded highest harvest index followed by phosphorus level P_3 (60 kg P_2O_5 ha^{-1}) and phosphorus level P_1 (0 kg P_2O_5 ha^{-1}) recorded lowest harvest index.

Effect of foliar application

Foliar application of BOOST- 52 (0:52:34) at 35 and 50 days (F_3) recorded significantly more plant height over all other treatments of foliar application of BOOST-52(0:52:34) at 75 DAS. Similar results were reported by Shinde and Bhilare (2003). Number of functional leaves per plant was influenced significantly due to foliar application of BOOST-52 (0:52:34), foliar application of BOOST- 52 (0:52:34) at 35 and 50 days (F_3) recorded significantly more number of functional leaves per plant over all other treatments of foliar application of BOOST-52(0:52:34). similar trend was observed in case of leaf area, number of branches and dry matter per plant.

Number of pods per plant influenced significantly due to different foliar application at. Foliar application of BOOST- 52 (0:52:34) at 35 and 50 days (F_3) recorded significantly more number of pods per plant over all remaining foliar application of BOOST-52(0:52:34). Foliar application of BOOST-52 (0:52:34) at 35 days (F_1) and foliar application of BOOST-52 (0:52:34) at 50 days (F_2) recorded significantly more number of pods per plant over no foliar application (F_0) and were at par with each other. Similar trend was observed in case of weight and number of seeds per plant whereas the effect of foliar application on 1000 seed weight was found to be non significant.

Data revealed that the seed yield was influenced significantly due to foliar application of BOOST-52 (0:52:34). Foliar application of BOOST-52 (0:52:34) at 35 and 50 DAS (F_3) recorded significantly highest seed yield (2387.7 kg ha^{-1}) over all other treatments of foliar application. Foliar application of BOOST-52 (0:52:34) at 35 days (F_1) and foliar application of BOOST-52 (0:52:34) at 50 days (F_2) recorded significantly higher seed yield over no foliar application (F_0) and were at par with each other. No foliar application (F_0) recorded significantly lowest seed yield (1891.7 kg ha^{-1}). Similar kind of variation was observed in case of straw and biological yield. These results are in conformity with those reported by Kalpana and Krishnarajan (2003).

Foliar application of BOOST-52 (0:52:34) at 35 and 50 days (F_3) recorded highest harvest index followed by foliar application of BOOST-52 (0:52:34) at 50 days (F_2). Foliar application of BOOST-52 (0:52:34) at 35 days (F_1) recorded lowest harvest index.

Interaction (P x F)

The interaction effect of phosphorus levels and foliar application on mean total dry matter was found to be non significant. The interaction effect of phosphorus levels and foliar applications in respect of seed yield

Table 1
Plant height(cm), No. of branches /plant, No. of functional leaves/plant, Leaf area/plant, Dry matter / plant of soybean as influenced by different treatments at 75 DAS

Treatment	*Plant height (cm)*	*No. of branches / plant*	*No. of functional leaves/plant*	*Leaf area/ plant(cm^2)*	*Dry matter / plant(g)*
Phosphorus levels					
P_1 - 0kg P_2O_5 ha^{-1}	45.64	3.77	16.88	480.97	30.96
P_2 - 30 kg P_2O_5 ha^{-1}	52.70	4.67	18.29	546.08	33.31
P_3 - 60 kg P_2O_5 ha^{-1}	54.51	4.97	19.10	572.78	34.84
S. E. ±	0.91	0.10	0.52	11.44	0.49
CD at 5%	2.69	0.30	1.54	33.51	1.44
Foliar application of BOOST-52 (0:52:34)					
F_0 – No foliar application	47.65	3.92	15.24	485.18	30.86
F_1 – Foliar application of BOOST-52 (0:52:34) at 35 DAS	50.13	4.34	18.04	530.98	32.58
F_2 - Foliar application of BOOST-52 (0:52:34) at 50 DAS	51.52	4.60	18.19	537.65	32.98
F_3 - Foliar application of BOOST-52 (0:52:34) at 35&50 DAS	54.49	5.05	20.90	537.65	34.92
SE±	1.06	0.12	0.61	13.21	0.57
CD at 5%	3.10	0.35	1.78	38.69	1.67
Interaction (P x F)					
S. E. ±	1.83	0.20	1.05	22.88	0.98
CD at 5%	NS	NS	NS	NS	NS
G. MEAN	50.95	4.47	18.09	533.28	32.84

Table 2
Pod weight (gm), seed weight (gm), number of seeds per plant and 1000 seed weight (gm) of soybean as influenced by different treatments

Treatment	*Number of pods per plant*	*Pod weight / plant*	*Seed weight/ plant*	*Number of seeds per plant*	*1000 seed weight*
Phosphorus levels					
P_1 - 0kg P_2O_5 ha^{-1}	32.30	12.62	8.10	67.71	121.83
P_2 - 30 kg P_2O_5 ha^{-1}	35.70	16.04	13.16	82.68	122.33
P_3 - 60 kg P_2O_5 ha^{-1}	37.55	17.93	13.87	87.78	124.64
S. E. ±	0.64	0.38	0.37	1.77	0.81
CD at 5%	1.88	1.13	1.09	5.20	NS
Foliar application of BOOST-52 (0:52:34)					
F_0 – No foliar application	32.40	12.35	9.48	71.15	121.73
F_1 – Foliar application of BOOST-52 (0:52:34) at 35 DAS	34.70	15.14	11.14	78.28	122.56
F_2 - Foliar application of BOOST-52 (0:52:34) at 50 DAS	35.60	16.20	12.25	80.55	123.25
F_3 - Foliar application of BOOST-52 (0:52:34) at 35&50 DAS	38.03	18.44	13.97	87.61	124.19
SE±	0.74	0.44	0.43	2.05	0.94
CD at 5%	2.17	1.30	1.20	6.01	NS
Interaction (P x F)					
S. E. ±	1.28	0.77	0.74	3.55	1.63
CD at 5%	NS	NS	NS	NS	NS

was found significant (table 4). The highest seed yield (2735 kg ha^{-1}) was recorded by the application of 60 kg P_2O_5 ha^{-1} with foliar application of BOOST-52 (0:52:34) at 35 and 50 days (P_3F_3) as compared to all other treatment combinations except P_2F_3 i.e. 30 kg P_2O_5 ha^{-1} with foliar application of BOOST-52 (0:52:34) at 35 and 50 days.

Table 3
Mean seed yield, straw yield, biological yield (kg ha^{-1}) and harvest index (%) as influenced by various treatments

Treatment	*Seed yield*	*Straw yield*	*Biological yield*	*Harvest index*
Phosphorus levels				
P_1 - 0kg P_2O_5 ha^{-1}	1671.2	2471.1	4147.5	40.31
P_2 - 30 kg P_2O_5 ha^{-1}	2280.2	3094.2	5374.4	42.43
P_3 - 60 kg P_2O_5 ha^{-1}	2393.0	3192.5	5668.7	42.21
S. E. ±	42.72	49.07	91.52	
CD at 5%	125.12	143.0	268.0	
Foliar application of BOOST-52 (0:52:34)				
F_0 – No foliar application	1891.7	2690.0	4581.7	41.28
F_1 – Foliar application of BOOST-52(0:52:34) at 35 DAS	2039.6	2850.0	5000.7	40.78
F_2 - Foliar application of BOOST-52(0:52:34) at 50 DAS	2141.7	2942.6	5095.3	42.03
F_3 - Foliar application of BOOST-52(0:52:34) at 35&50 DAS	2387.7	3194.6	5576.4	42.81
SE±	49.33	56.66	105.68	
CD at 5%	144.4	165.9	309.48	
Interaction (P x F)				
S. E. ±	85.44	98.14	183.04	
CD at 5%	250.23	NS	NS	
G. Mean	2115.1	2919.3	50635.0	41.69

Table 4
Mean seed yield of soybean as influenced by interaction of phosphorus levels with foliar application of BOOST-52 (0:52:34) at harvest

Treatments	*Foliar application*			
Phosphorus levels	F_0	F_1	F_2	F_3
P_1	1580.0	1686.0	1695.0	1728.0
P_2	1940.0	2210.7	2270.0	2700.0
P_3	2155.0	2222.0	2460.7	2735.0
S. E. ±	85.44			
CD at 5%	250.23			

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