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Effect of different levels of nitrogen and phosphorus on growth and yield of niger (*Guizotia abyssinica* L. Cass)

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Abstract
A field experiment was conducted to study the effect of different levels of nitrogen and phosphorus on growth and yield of Niger during *Kharif* season, 2002-2004 at Zonal Agricultural Research Station, Western Ghat Zone, Igatpuri Dist-Nasik (M.S.). Niger variety IGP-76 was sown in *kharif* season in randomized block design with twelve treatment and three replications. The plant spacing was 30x10 cm with plot size 3.60 x 2.40 m^2. The soil of the experiment field was shallow laterite. The result revealed that the treatment T_{12} (N @ 40 kg/ha + P @ 40 kg/ha (20kg/ha through SSP + 20 kg/ha through RPen) +PSB) produced significantly higher seed yield of Niger (508 kg/ha), gross monetary returns (Rs.9295/ha) and net return (Rs.4626/ha) than rest of the treatments. However, application of N@40 kg/ha + P@20 kg/ha through SSP+PSB is followed to treatment T_{12} with seed yield of 502 kg/ha, gross monetary returns of Rs.8827/ha, Net return Rs.4519/ha and highest B:C ratio of 1:2.02. In spite of such significance the productivity of this crop is very low which may be enhanced by adequate and integrated management of nutrient supply especially phosphorus, because being oilseed crops niger responds well to phosphorus. It was concluded that the seed yield and ancillary characters were significantly influenced due to different levels and sources of phosphorus. It significantly produce higher seed yield than the control and rest of the treatment combinations, during both three years as well as in pooled analysis.

Keywords: Niger, nitrogen, phosphorus.

Introduction
Niger (*Guizotia abyssinica* (L. Cass) seeds contain a considerable quantity of edible oil (38 to 43%), protein (20%), sugar (12%) and minerals essential for human and animal meals (Gentinet and Teklewold, 1995) [10]. India is the chief producer of niger seeds and ranks on the second and fourth position in the world for its acreage and annual production, respectively. Being a minor oilseed crop niger is most hardy and drought tolerant occupying a prominent place where moisture is the limiting factor and soils are sub-marginal to marginal in several parts of the country. Among the oilseed crops, Niger is considered to be a crop for resource poor farmers particularly in developing countries like India. It is generally grown with minimum agro inputs, nutrient stress is the most important factor responsible for its low productivity. In India, niger is grown in an area of 4.6 lakh ha with a production of 1.32 lakh tonnes and productivity of 262 kg/ha (Anonymous, 2014) [1]. Though India earns Rs.30 crores through export of niger seed. Niger contributes about 3% of Indian oilseed production (Damodaran and Hegde, 2003) [6]. The niger seeds which are small and shiny black contain 30-405 good quality edible oil. It is mainly grown in tribal pockets with the use of minimum agro inputs, particularly fertilizers leading to very low productivity (Sharma, 1993). Further this will fulfil the demand of ever increasing edible oil. In spite of such a significance the productivity of this crop is very low which may be enhanced by adequate and integrated supply of nutrient especially phosphorus, because being oilseed crop niger respond well to phosphorus, Hence yield potential of this crop can be improved through adequate supply of phosphorus. Indian soils which are generally low to medium in available phosphorus and the phosphorus supply through fertilizers is still below the optimum level due to very high prices of phosphatic fertilizers. Moreover, the efficiency of applied phosphorus seldom exceeds 20 to 25% to the current crop and the remaining parts get converted in to relatively unavailable forms. In this context several strains of phosphorus solubilising Bacteria (PSB), phosphorus solubilising Microbes (PSM) and Fungi have been isolated, which have capacity to solublize

the applied as well as native phosphorus. The integrated phosphorus management involving the conjunctive use of fertilizers and organic sources assumed great importance recently due to paucity of phosphatic fertilizers and need to sustain productivity (Nambaiar and Abrol, 1989) [11].

Material and Methods

The field experiment was conducted to study the effect of different levels of nitrogen and phosphorus and different sources of phosphorus to maximise Niger yield during *Kharif* season, 2002-2004 at AICRP on Niger, Zonal Agricultural Research Station, Western Ghat Zone, Igatpuri Dist-Nasik (M.S.). It is situated between 15^0- 17^0 and 19-35'N latitude and 73^0-15' and 75^0-58' E longitude. It is unevenly narrow strip extending from North to south along the erest of the sayadri ranges with an altitude about 500m.towards the eastern slops of ranges and up to 2000m. Western sea word side. The western Ghat zone extends over a total geographical area of 4.5 lakh ha covering about 1.46 percent of the total state geographical area. The average annual rainfall of the zone ranges between 2000 mm to 6050 mm mostly through south west monsoon. The no. of rainy days from 92 to 120 days. The maximum and minimum temperature ranges from 31.1to39.9^0C. and 9.8 to 12.5^0C respectively. The soil of the experiment field was shallow laterite having pH 6.72,electric conductivity (EC) 0.13ds/m., low in organic carbon content (0.28%), low in available nitrogen (174 kg/ha), moderate in available phosphorus (17.5 kg/ha)and moderate in available potassium (178 kg /ha).

Niger variety IGP-76 was sown in Kharif season in randomized block design with twelve treatment and three replications. The plant spacing was 30x10 cm with plot size 3.60 x 2.40 m^2 and seed @ 5 kg/ha. The soil of the experiment field was shallow laterit, red silty loam, having pH 6.72, electric conductivity (EC) 0.13dS/m., low in organic carbon content (0.28%), low in available nitrogen (174 kg/ha), moderate in available phosphorus (17.5 kg/ha) and moderate in available potassium (178kg/ha).

Table 1: Details of treatment with symbols

Sr. No.	Treatment	Symbol used
1	Control	T_1
2	N@20 kg/ha.	T_2
3	N@20 kg/ha +PSB (soil application) @ 5 kg/ha.	T_3
4	N@20 kg/ha + P@20 kg/ha through DAP+PSB	T_4
5	N@20 kg/ha + P@20 kg/ha through SSP+PSB	T_5
6	N@20 kg/ha + P@20 kg/ha through RPen+PSB	T_6
7	N@40 kg/ha + PSB	T_7
8	N@40 kg/ha + P@20 kg/ha through DAP+PSB	T_8
9	N@40 kg/ha + P@20 kg/ha through SSP+PSB	T_9
10	N@40 kg/ha + P@20 kg/ha through RPen+PSB	T_{10}
11	N@40 kg/ha + P@40 kg/ha(20kg/ha through DAP + 20 kg/ha through RPen)+PSB	T_{11}
12	N@40 kg/ha + P@40 kg/ha(20kg/ha through SSP + 20 kg/ha through RPen)+PSB	T_{12}

PSB:-Phosphorus solubilising Bacteria

RPen:- Rock Phosphate enriched with FYM 15 days prior to application (1:3,phosphate: FYM)

Result and Discussion

The data obtained was analyzed as per the randomized block design. The treatment differences were found to be significant. The treatment combination N@40 kg/ha + P@20 kg/ha through SSP+PSB (T_9) gave significantly higher seed yield of 514 kg/ha, with highest gross monetary returns of Rs. 7453/ha and net monetary returns of Rs. 3883/ha and highest B: C ratio (2.04) than the rest of the treatment combinations. The treatment combinations of T_8, T_{10}, T_{11} and T_{12} were at par with each other and significantly superior over control and 20 kg N/ha and other treatments combination during last year Kharif 2004. It is observed that when the pooled data of three years (2002-2004) analysed, that the differences in seed yield due to different phosphorus levels and sources were statistically significant. The treatment T_{12} (N@40 kg/ha + P@40 kg/ha (20kg/ha through SSP + 20 kg/ha through RPen) +PSB) produced significantly higher seed yield of Niger (508 kg/ha), gross monetary returns (Rs.9295/ha) and net return (Rs.4626/ha) than rest of the treatments. However, application of N@40 kg/ha + P@20 kg/ha through SSP+PSB is followed to treatment T_{12} with seed yield of 502 kg/ha, gross monetary returns of Rs.8827/ha, Net return Rs.4519/ha and highest B:C ratio of 1:2.02. The increase in plant height, number of branches per plant in response to application of chemical fertilizers is probably due to enhanced availability of nutrients. The variation in plant height due to nutrient sources was considered to be due to variation in the availability of major nutrients. More number of branches and plant height might be due to the more availability of nitrogen, which plays a vital role in cell division. Several workers have reported marked superiority in growth parameters like plant height and branches/plant due to adequate nutrient supply in niger (Kachapur & Radder, 1983 [14] b; Trivedi *et al*., 1988 [13]; Gautam, 2009) [2]. The productivity of niger plant is greatly dependent on the number of capitulate per plant and number of seeds per capitula. In present investigation maximum number of capitulate per plant and number of seeds per capitula were observed in the all the treated plants. Similar increase in these yield attributes have also been advocated by the several researchers (Paikray *et al*., 1990 [12] Gautam, 2009) [2]. Application of phosphorus increased the photosynthetic and microbial activities and translocation of photosynthates, wich resulted in higher seed yield. The present results are in consonance with those of Tiwari and Bisen (1965) Singh and Verma (1975); Agrawal *et.al.* (1996) [9]; Deshmukha *et.al.* (2002) [7] & Jadhav and Deshmukha (2008) [3]. These result are also in consonance and related with those of Paikray *et.al.* (1997) [8].

Table 2: Pooled Mean seed yield of Niger (kg/ha.) and its economics (Kharif 2002-2004)

Sr. No.	Treatment Details	Mean Seed Yield kg/ha				GMR Rs./ha	Cost of Cult. Rs./ha	Net return Rs./ha	B:C ratio
		2002	2003	2004	Pooled				
1	Control	260	269	256	261	4764	3496	1268	1.36
2	N@20 kg/ha.	360	367	350	359	6538	3985	2553	1.68
3	N@20 kg/ha +PSB (soil application) @ 5 kg/ha.	373	491	411	400	7266	4070	3196	1.82
4	N@20kg/ha+ @20 kg/ha through AP+PSB	385	400	383	389	7085	4298	2787	1.68
5	N@20 kg/ha + P@20 kg/ha through SSP+PSB	398	439	436	425	7689	4387	3302	1.70
6	N@20 kg/ha + P@20 kg/ha through RPen+PSB	363	398	417	393	7084	4271	2813	1.70
7	N@40 kg/ha + PSB	420	475	464	453	8209	4254	3955	1.96
8	N@40 kg/ha + P@20 kg/ha through DAP+PSB	442	508	494	482	7886	4320	3566	1.83
9	N@40 kg/ha + P@20 kg/ha through SSP+PSB	460	533	514	502	8827	4308	4519	2.02
10	N@40 kg/ha + P@20 kg/ha through RPen+PSB	425	494	481	466	8452	4437	4015	1.93
11	N@40 kg/ha + P@40 kg/ha(20kg/ha through DAP + 20 kg/ha through RPen)+PSB	472	514	506	498	9017	4605	44124	1.98
12	N@40 kg/ha + P@40 kg/ha(20kg/ha through SSP + 20 kg/ha through RPen)+PSB	490	528	510	508	9295	4669	4626	2.01
	SE+-	18.16	21.50	15.25	15.25	330			
	C D at 5%	52.13	63.08	44.75	44.17	970			
	C V %	7.80	8.67	6.03	6.15	7.17			

PSB:- Phosphorus solubilising Bacteria

RPen:- Rock Phosphate enriched with FYM 15 days prior to application (1:3, phosphate:FYM)

Table 3: Pooled Mean Ancillary characters of Niger (Kharif 2002-2004)

Sr. No.	Treatment Details	No. of branches per plant	No. of capitula per plant	No. of seeds per capitula	Average plant height(cm)
1	Control	6.0	29	23	158.3
2	N@20 kg/ha.	7.0	32	23	159.0
3	N@20 kg/ha +PSB (soil application) @ 5 kg/ha.	7.0	32	24	156.7
4	N@20kg/ha+ @20 kg/ha through AP+PSB	7.3	33	25	176.7
5	N@20 kg/ha + P@20 kg/ha through SSP+PSB	7.6	34	23	166.7
6	N@20 kg/ha + P@20 kg/ha through RPen+PSB	8.0	32	23	178.3
7	N@40 kg/ha + PSB	8.0	34	24	180.0
8	N@40 kg/ha + P@20 kg/ha through DAP+PSB	7.6	34	23	181.7
9	N@40 kg/ha + P@20 kg/ha through SSP+PSB	8.4	35	24	183.3
10	N@40 kg/ha + P@20 kg/ha through RPen+PSB	8.0	33	23	186.7
11	N@40 kg/ha + P@40 kg/ha(20kg/ha through DAP + 20 kg/ha through RPen)+PSB	8.3	35	24	176.7
12	N@40 kg/ha + P@40 kg/ha(20kg/ha through SSP + 20 kg/ha through RPen)+PSB	8.5	36	25	183.3
	SE+-	0.46	0.51	0.90	
	C D at 5%	1.37	1.50	2.78	

PSB:- Phosphorus solubilising Bacteria

RPen:- Rock Phosphate enriched with FYM 15 days prior to application (1:3, phosphate: FYM)

Conclusion

It is concluded that as the seed yield and ancillary characters influenced significantly due to different phosphorus management treatment combinations and phosphorus fertilized crop gave significantly higher seed yield than the control and rest of the treatment combinations, during both three years as well as in pooled analysis. The result were approved in sesame & Niger Vth Annual Workshop (2004-2005), Agricultural Research station, RAU, Mandor, Jodhapur (Rajasthan), April, 9-10, 2005 as recommended that "Application of 20kg/ha each of nitrogen and phosphorus (SSP) along with soil application of 5 kg PSB/ha resulted in producing considerably higher mean seed yield of niger and gross monetary return compared to that obtained without phosphorus. The phosphorus application increased the photosynthetic and microbial activities and translocation of photosynthates, wich resulted in higher seed yield. These result are also in consonance and related with those of Paikray *et.al.* (1997) [8].

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