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Influence of Varieties and Integrated Nutrient Management on Yield Attributes Parameters of Isabgol (*Plantago ovata* Forsk.) under Northern Dry Zone of Karnataka, India

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A B S T R A C T

The field research was conducted to evaluate the performance of yield attributes of two Isabgol cultivars for commercial production in northern dry zone of Karnataka during two years 2015-16 and 2016-17. The experiment was laid out in split plot design (SPD) with sixteen INM treatment combinations at the College of Horticulture, Bagalkot. analysis with pooled data exhibited higher value was recorded in Vallabh Isabgol-1in growth parameters *viz.*, early number of days taken for 50% seed flowering (62.00), number of spikes per plant (38.87), number of spikelets per spike (84.84), spike length (3.58cm), seed yield of (12.39 q ha^{-1}) as compared to Gujarat Isabgol-2 (11.08 kg ha^{-1}). Whereas the higher values with INM treatments with respect to plant yield attributes were observed in *Viz*. N_{11}-75 % RD of FYM **(**7.5 t ha^{-1}) + 75% RD of NPK (37.5:18.75:22.50 kg ha^{-1}) +*Azospirillum* (5kg ha^{-1}) + PSB (3kg ha^{-1}) + $ZnSO_4$ (15 kg ha^{-1}) + $FeSO_4$ (7.5 kg ha^{-1}) *viz* early number of days taken for 50% seed flowering(56.35), number of spikes per plant (38.87), number of spikelet's per spike (84.84), spike length (3.58 cm), seed yield of (15.43 q ha^{-1}).Higher values for interaction effect on growth parameters were recorded in V_1N_{11}*viz*.,early number of days taken for 50% seed flowering (55.57), number of spikes per plant (48.20), number of spikelets per spike (104.62), spike length (4.31 cm), seed yield (15.59 q ha^{-1}).

Introduction

Isabgol seeds and husk are mainly used in medicine because of mucilaginous nature. It is used as safe bulk-laxative, promoting regular bowel movement. It is a popular medicinal crop in Ayurvedic and Unani systems of medicine for problems like chronic diarrhoea, dysentery, constipation, reducing cholesterol and treatment of cancer. Recent studies have shown that, an intake of 10.2 g of husk per day as part of a diet significantly lowers the blood cholesterol level. Since 1998, the US Food and Drug Administration approved the health claim on the association between consumption of Isabgol husk and reduction in risk of

coronary heart disease. The seeds are also used for the treatment of chronic amoebic dysentery, where constipation is one of the main symptoms (Kumar *et al.,* 2015)..

India is the only country producing maximum Isabgol produce in the international trade. Country earns on an average ₹ 1168.34 crores annually from its exporter (Department of commerce). It is widely cultivated in north Gujarat (₹1504 Lakhs), adjoining Rajasthan (₹ 25,107Lakhs) and Madya Pradesh over an area of about 1,50,000 ha (Anonymous 2015a) Rajasthan is one of the leading states in India and is mainly grown in Bikaner, Jalor, Jodhpur and Pali districts followed by Gujarat both States- out put valued ₹ 26,611 crores of Isabgol crop (Anonymous 2015b). It produces around 90,000 to 1,00,000 tonnes of Isabgol every year of which Gujarat accounts for around 22-26 per cent share. The productivity of the crop has remained in the range of 632 kg to 672 kg per hectare in the state.

Isabgol cultivation In Karnataka is very meager and only local cultivars are grown with poor yield. There is a wide yield gap between local cultivars and high yielding varieties. Performance of any crop or variety depends upon inherent genetic potential make up, of variety and response to climatic condition of the zone. To attain increased productivity, studies on INM have been carried out with an aim to identify suitable cultivar.

Materials and Methods

The experiment was conducted in the field at Department of Plantation Spices Medicinal and Aromatic Plants, College of Horticulture, Bagalkot at Haveli farm during the years 2015-16 and 2016-17. Geographically, this experimental site lies in Northern Dry Zone (Zone-3) of Karnataka state in the agro-climatic zone of Karnataka, situated at 16° North latitude and 74°59' East longitude and at an altitude of 533.0 m above mean sea level

The soil of experimental field was red clay loamy in texture, with percentages of sand 22.60, silt 26.10 and clay52.20 bulk density 1.25, EC 0.24 dS m^{-1} and pH 8.22 (alkaline in reaction) with organic carbon 1.63 and available N 268.02, 34.80, 273.69 NPK kg ha^{-1}. The source of seed collection was DMAPR Anandh Gujarat *i.e.* Vallabh Isabgol-1 and Gujarat Isabgol-2. Seed were sown in 18 November 2015 and 2016 with gross plot size of 3.6 m x 1.5 m = 5.40 m^2 in split plot design in sixteen INM sub treatments with three replications as subplot listed below.

N_1 -RDF FYM **(**10 t ha^{-1}) + RDF NPK (50:25:30 kg ha^{-1})
N_2-RDF FYM **(**0 t ha^{-1}) + RDF NPK (50:25:30 kg ha^{-1}) +$ZnSo_4$ (15 kg ha^{-1})
N_3-RDF FYM **(**10 t ha^{-1}) + RDF NPK (50:25:30 kg ha^{-1}) +$FeSo_4$ (7.5 kg ha^{-1})
N_4-RDF FYM **(**10 t ha^{-1}) + RDF NPK (50:25:30 kg ha^{-1}) +$FeSo_4$ (7.5 kg ha^{-1}) + $ZnSo_4$ (15 kg ha^{-1})
N_5-Vermicompost (1t ha^{-1}) + RDF NPK (50:25:30 kg ha^{-1})
N_6-Vermicompost (1t ha^{-1}) +50% RDF NPK (50:25:30 kg ha^{-1})+ *Azospirillum*(5kg ha^{-1}) + *Azotobacter* (5kg ha^{-1})
N_7-75% RD FYM **(**7.5 t ha^{-1}) + 75% RDF NPK (37.5:18.75:22.50 kg ha^{-1})
N_8-75% RD FYM **(**7.5 t ha^{-1}) +75% RDF NPK (37.5:18.75:22.50 kg ha^{-1}) + *Azotobacter* (5kg ha^{-1})**,**
N_9-75% RD FYM **(**7.5 t ha^{-1}) +75% RDF NPK (37.5:18.75:22.50 kg ha^{-1})+ *Azospirillum* (5kg ha^{-1})
N_{10}-75% RD FYM **(**7.5 t ha^{-1}) +75% RDF NPK (37.5:18.75:22.50 kg ha^{-1}) + *PSB* (3kg ha^{-1})
N_{11}-75%RDF FYM **(**7.5 t ha^{-1}) + 75% RDF NPK (37.5:18.75:22.50 kg ha^{-1})+*Azospirillum*(5kg ha^{-1})+ *PSB* (3kg ha^{-1})+$ZnSo_4$(15kg ha^{-1}) + $FeSo_4$ (7.5 kg ha^{-1})

N_{12}-50%RDF FYM (5t ha^{-1}) + 50% RDF NPK (25:12.5:15 NPK kg ha^{-1})
N_{13}-50% RD FYM (5t ha^{-1}) +50% RDF NPK (25:12.5:15 kg ha^{-1}) +*Azotobacter* (5kg ha^{-1})
N_{14}-50% RDF FYM (5t ha^{-1}) +50% RDF NPK (25:12.5:15 kg ha^{-1}) +*Azospirillum* (5kg ha^{-1})
N_{15}-50% RD FYM (5t ha^{-1}) +50% RDF NPK (25:12.5:15 kg ha^{-1}) +*PSB* (3kg ha^{-1})
N_{16}-50%RD FYM (5t ha^{-1}) +75% RDF NPK (37.5:18.75:22.50 kg ha^{-1}) + *Azospirillum* (5kg ha^{-1}) +*PSB* (3kg ha^{-1})+$Znso_4$ (15kg ha^{-1})+$FeSo_4$(7.5 kg ha^{-1})

The experiment after layout then treatments were applied as per above nutrient combination, then mixed thoroughly in plots before imposing the treatments. Zinc was applied in the form of $ZnSo_4$ at the time of sowing half dose of N was applied as a basal and remaining half was applied one month after sowing as top dressing full dose of P and K were applied at the time of sowing below the seed in furrows made with the help of land hoe.

Manual thinning weeding and hoeing were done at one month after sowing to provide an ideal environment to the crop a light irrigation was given immediately before sowing, however six and seven irrigation were given as per requirement of the crop with the help of sprinkler.

Five plants were selected randomly in each plot, were recorded dry matter of plants per meter row length growth parameter were recorded at the time of harvest in each plot at all the stages of crop however the yield parameters were recorded at harvest stages values were discussed here for dry matter production analysis the mean values of all the observations were worked out. Five plants were selected in each plot and cut at ground level at 30^{th}, 60^{th}, 90^{th} and till at harvest stage. After recording their fresh weight, the samples were dried under shade followed by hot air oven at 65°C temperature till constant weight was obtained and oven dry weights were recorded. The dry matter production was worked out by multiplying the dry weight of single plant with corresponding plant density per hectare and RGR (g $g^{-1}day^{-1}$) and CGR (g m^{-2} day^{-1}).

Results and Discussion

The significantly higher reproductive parameters *viz.*, number of days taken for 50% flowering (62.00), number of spikes per plant (38.87), spikelets per plant (84.84) and spike length (cm) were recorded in Vallabh Isabgol-1 (3.58) as compared to Gujarat Isabgol-2 (3.43).

This was mainly due to genetic makeup of the variety and increase in vegetative phase which results towards the plant to enter early reproductive phase further more dry matter accumulation in plants, this variation caused due to it took longer vegetative period because of in enhanced photosynthesis and metabolic activities consequently enabling the plants to bear more spikes of longer size with healthy root and development of higher number of spikelets per plant it requires optimum weather conditions at spike initiation stage in Isabgol reported by Mirshekari and Forouzandeh (2015), Shivran *et al.,* (2016) and Tyagi *et al.,* (2016).

The early days taken for 50 per cent flowering were significantly influenced by integrated nutrient management with application of 75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + $ZnSO_4$ + $FeSO_4$ (N_{11})56.35, which was on par with application of RD of FYM + RD of NPK+ $ZnSO_4$ + $FeSO_4$ (N_4) 57.14, Vermicompost + 50 % RD of NPK + *Azospirillum* + *Azotobacter* (N_6) 58.50, 50 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + $ZnSO_4$ + $FeSO_4$ (N_{16})58.40 resulted because of balanced

application of INM nutrients lead to increase in vegetative parameters like plant height, number of leaves and tillers per plant by which accumulated more photosynthates positively correlated to increase plant growth. Increased number of tillers and length of spikes might have also resulted to early days taken for 50 per cent flowering with application of FYM in combination with NPK adds more nutrients to soil released at an optimum faster rate, which helps in maintaining continuous supply of nutrients to the plant leads to greater availability of nutrients to plant have enhanced meristematic activity leading to increased plant growth parameters towards dry matter accumulation in plants resulted early flowering reported by Choudhary *et al.,* (2014) and Shinde *et al.,* (2014).

Significantly higher number of spikes per plant (47.13) was recorded with N_{11} (75% RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + $ZnSO_4$ + $FeSO_4$) which was on par with N_4 (46.26), N_{16} (46.08) and N_6 (45.64). The lower number of spikes per plant (32.35) was recorded in N_{13} (50 % RD of FYM + 50 % RD of NPK + *Azatobacter*) during pooled data.

The significantly higher spikelets per plant (103.60) was recorded in N_{11} (75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + $ZnSo_4$ + $FeSo_4$) which was on par with N_4 (103.16), N_{16} (102.15) and N_6 (102.07). The lower number of spikelets per plant (59.88) was recorded in N_{13} (50 % RD of FYM + 50 % RD of NPK + *Azatobacter*) during pooled data. Similarly INM effect significantly higher spike length (4.26 cm) was recorded with N_{11}, which was on par with N_4 (4.14 cm), N_6 (4.08 cm) and N_{16} (4.05 cm).

The lower spike length (2.98, 2.96 cm) was recorded in N_{13} during pooled data. This may be INM treatments combination attributed to increase in number of spikes per plant was due to accumulation of carbohydrates with application of balance doses of N P K and FYM along with biofertilizer also enhanced the biosynthesis of photosynthetic pigments by creating favourable cellular environment and providing nutrients. Nitrogen is involved in chloroplast development and is an essential unit of chlorophyll molecule.

Similarly the phosphorus and potassium which are also major nutrients and are involved in various vital processes, which intern accelerated the development of leaf number, positively correlated with length of spikes and increase in number of tillers per plant.

Plants take phosphorus in soluble form but in soil it was present as insoluble phosphates form there by not utilized by plants *PSB* helps for conversion of these nutrients. The positive effect of zinc towards plant growth and yield attributes, as it favours enzyme system, auxin and protein synthesis and seed production directly or indirectly in plants. These results are in line with Dinesh and Jha (2000), Nadim *et al.,* (2011), Tripathi *et al.,* (2013) and Shivran *et al.,* (2015).

The interaction effect on 50 per cent flowering was observed with respect to the varieties and integrated nutrient management. Significantly less number of days taken for 50 per cent flowering (55.57) was observed in V_1 supplied with N_{11} which was on par V_1N_4 (56.63) followed by V_2N_{11} (57.12), V_2N_4 (57.64) and V_1N_{16} (58.21). The more number of days taken for 50 per cent flowering (70.89) was recorded in V_2N_{13} during pooled data. The significantly higher number of spikes per plant (47.13) was recorded in Vallabh Isabgol-1 supplied with N_{11} (75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + PSB + $ZnSO_4$ + $FeSO_4$) which was on par with V_1N_4 (46.26), followed by V_2N_6 (47.11) and V_1N_{16} (46.75). Whereas lower number of spikes plant (30.60) was recorded V_2N_{13} during pooled data.

Table.1 Yield parameters on number of days taken for 50% flowering, number of spikes per plant, and seed yields (q ha^{-1}) as influenced by Isabgol varieties and integrated nutrient management

Varieties / Nutrients	Number of days taken for 50% flowering									Number of spikes per plant								
	2015			2016			Pooled data			2015			2016			Pooled data		
Nutrients	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**
N_1 - RDF FYM + RDF NPK (kg ha^{-1})	8.72	7.97	**8.34**	8.56	8.12	**8.34**	8.64	8.04	**8.34**	2.51	2.37	**2.44**	2.53	2.41	**2.47**	2.52	2.39	**2.45**
N_2 RDF FYM + RDF NPK+ $ZnSo_4$	8.69	8.48	**8.59**	8.60	8.37	**8.49**	8.65	8.43	**8.54**	2.65	2.20	**2.42**	2.80	2.37	**2.59**	2.72	2.29	**2.51**
N_3 RDF FYM + RDF NPK+$FeSo_4$	8.70	8.24	**8.47**	8.55	8.27	**8.41**	8.63	8.26	**8.44**	2.66	2.59	**2.62**	2.80	2.66	**2.73**	2.73	2.62	**2.68**
$N_4$75% RDF FYM + 75% RDF NPK + AZB	9.09	9.15	**9.12**	9.18	9.11	**9.14**	9.13	9.13	**9.13**	3.28	3.10	**3.19**	3.31	3.17	**3.24**	3.30	3.14	**3.22**
N_5 Vermicompost (1 t ha^{-1}) + RDF NPK	8.74	8.37	**8.55**	8.56	8.36	**8.46**	8.65	8.36	**8.51**	2.46	2.51	**2.48**	2.54	2.61	**2.58**	2.50	2.56	**2.53**
N_6 Vermicompost + 50% RDF NPK + ASP + AZB	9.18	9.25	**9.21**	9.15	9.10	**9.13**	9.16	9.18	**9.17**	3.32	3.17	**3.25**	3.49	3.24	**3.37**	3.41	3.21	**3.31**
$N_7$75% RDF FYM + 75% RDF NPK	8.52	8.42	**8.47**	8.52	8.37	**8.44**	8.52	8.40	**8.46**	2.52	2.26	**2.39**	2.69	2.34	**2.52**	2.61	2.30	**2.46**
$N_8$75% RDF FYM + 75% RDF NPK + AZB,	8.49	8.44	**8.46**	8.43	8.53	**8.48**	8.46	8.48	**8.47**	2.65	2.16	**2.41**	2.75	2.29	**2.52**	2.70	2.23	**2.46**
$N_9$75 % RDF FYM +75% RDF NPK +ASP	8.66	8.34	**8.50**	8.66	8.29	**8.47**	8.66	8.31	**8.48**	2.32	2.36	**2.34**	2.44	2.48	**2.46**	2.38	2.42	**2.40**
N_{10}75% RDF FYM + 75% RDF NPK + PSB	8.62	8.31	**8.46**	8.64	8.29	**8.46**	8.63	8.30	**8.46**	2.34	2.23	**2.28**	2.16	2.35	**2.25**	2.25	2.29	**2.27**
N_{11}50% RDF FYM + 50% RDF NPK + PSB	9.27	9.21	**9.24**	9.32	9.25	**9.28**	9.30	9.23	**9.26**	3.38	3.35	**3.36**	3.64	3.34	**3.49**	3.51	3.34	**3.43**
N_{12}50% RDF FYM + 75% RDF NPK + ASP + PSB + $ZnSo_4$ + $FeSo_4$	8.48	8.39	**8.43**	8.45	8.40	**8.42**	8.46	8.39	**8.43**	2.51	2.25	**2.38**	2.66	2.75	**2.71**	2.59	2.50	**2.55**
N_{13}50% RDF FYM + 50% RDF NPK + AZB	8.43	8.15	**8.29**	8.36	8.21	**8.29**	8.40	8.18	**8.29**	2.15	1.91	**2.03**	2.31	2.68	**2.50**	2.23	2.29	**2.26**
N_{14}50% RDF FYM + 50% RDF NPK + ASP	8.63	8.34	**8.49**	8.56	8.39	**8.47**	8.60	8.37	**8.48**	2.46	2.48	**2.47**	2.67	2.62	**2.64**	2.56	2.55	**2.56**
N_{15} 50% RDF FYM + 50% RDF NPK + PSB	8.43	8.27	**8.35**	8.47	8.33	**8.40**	8.45	8.30	**8.38**	2.34	2.79	**2.56**	2.67	2.85	**2.76**	2.51	2.82	**2.66**
N_{16}50% RDF FYM + 75% RDF NPK + ASP + PSB + $ZnSo_4$ + $FeSo_4$	9.24	9.22	**9.23**	9.18	9.05	**9.12**	9.21	9.13	**9.17**	3.27	3.29	**3.28**	3.43	3.36	**3.40**	3.35	3.33	**3.34**
MEAN	**8.74**	**8.53**		**8.70**	**8.53**		**8.72**	**8.53**		**2.68**	**2.56**		**2.81**	**2.72**		**2.74**	**2.64**	
	S.Em ±	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**	
Varieties (V)	**0.024**	**0.072**		0.016	**0.048**		**0.017**	**0.051**		0.067	**NS**		0.046	**NS**		**0.056**	**NS**	
Nutrients (N)	**0.074**	**0.21**		0.050	**0.14**		**0.059**	**0.17**		0.087	**0.25**		0.108	**0.31**		**0.088**	**0.25**	
N at same V	**0.105**	**0.30**		0.070	**0.20**		**0.084**	**0.24**		0.123	**NS**		0.153	**NS**		**0.125**	**NS**	
Vat same or different N	**0.097**	**0.27**		0.064	**0.18**		**0.067**	**0.19**		0.262	**NS**		0.181	**NS**		**0.220**	**NS**	

Table. 2 Growth parameters on number of spikelet's per spike, spike length (cm)) and Seed yield (q ha^{-1}) as influenced by Isabgol varieties and integrated nutrient management

Varieties / Nutrients	Number of spikelets per spike									Spike length (cm)									Seed yield (q ha^{-1})								
	2015			2016			Pooled data			2015			2016			Pooled data			2015			2016			Pooled data		
Nutrients	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
N_1	0.1119	0.1042	**0.1080**	0.1126	0.1030	**0.1078**	0.1123	0.1036	**0.1079**	0.0769	0.0872	**0.0820**	0.0761	0.0793	**0.0777**	0.0765	0.0833	**0.0799**	12.05	9.43	**10.74**	12.93	9.62	**11.27**	12.49	9.52	**11.01**
N_2	0.1037	0.1030	**0.1034**	0.1082	0.0985	**0.1034**	0.1060	0.1008	**0.1034**	0.0791	0.0871	**0.0831**	0.0754	0.0807	**0.0781**	0.0772	0.0839	**0.0806**	12.51	9.49	**11.00**	13.22	9.80	**11.51**	12.86	9.65	**11.26**
N_3	0.1020	0.0988	**0.1004**	0.1087	0.1005	**0.1046**	0.1054	0.0997	**0.1025**	0.0719	0.0634	**0.0676**	0.0732	0.0663	**0.0698**	0.0725	0.0649	**0.0687**	11.79	11.85	**11.82**	12.43	12.14	**12.28**	12.11	11.99	**12.05**
N_4	0.1061	0.1186	**0.1124**	0.1239	0.1231	**0.1235**	0.1150	0.1209	**0.1179**	0.0870	0.0870	**0.0870**	0.0874	0.0880	**0.0877**	0.0872	0.0875	**0.0874**	14.84	14.86	**14.85**	15.55	15.22	**15.39**	15.19	15.04	**15.12**
N_5	0.0932	0.0943	**0.0937**	0.1085	0.1024	**0.1055**	0.1008	0.0984	**0.0996**	0.0732	0.0665	**0.0699**	0.0715	0.0686	**0.0701**	0.0724	0.0675	**0.0700**	10.56	10.49	**10.53**	10.89	10.58	**10.73**	10.72	10.54	**10.63**
N_6	0.1176	0.1201	**0.1188**	0.1498	0.1101	**0.1299**	0.1337	0.1151	**0.1244**	0.0838	0.0835	**0.0836**	0.0828	0.0868	**0.0848**	0.0833	0.0851	**0.0842**	14.87	14.81	**14.84**	15.29	14.34	**14.82**	15.08	14.57	**14.83**
N_7	0.1118	0.0951	**0.1035**	0.1141	0.1045	**0.1093**	0.1129	0.0998	**0.1064**	0.0750	0.0734	**0.0742**	0.0747	0.0721	**0.0734**	0.0748	0.0727	**0.0738**	10.33	9.00	**9.66**	10.80	9.14	**9.97**	10.56	9.07	**9.82**
N_8	0.0999	0.0953	**0.0976**	0.1133	0.1031	**0.1082**	0.1066	0.0992	**0.1029**	0.0780	0.0761	**0.0771**	0.0760	0.0727	**0.0743**	0.0770	0.0744	**0.0757**	10.14	9.38	**9.76**	10.29	8.62	**9.45**	10.21	9.00	**9.61**
N_9	0.1116	0.0930	**0.1023**	0.1153	0.0937	**0.1045**	0.1135	0.0933	**0.1034**	0.0803	0.0746	**0.0775**	0.0792	0.0715	**0.0754**	0.0798	0.0731	**0.0764**	10.10	9.16	**9.63**	10.03	9.37	**9.70**	10.06	9.27	**9.67**
N_{10}	0.1209	0.1073	**0.1141**	0.1120	0.1129	**0.1124**	0.1164	0.1101	**0.1133**	0.0790	0.0709	**0.0749**	0.0770	0.0729	**0.0750**	0.0780	0.0719	**0.0750**	10.36	9.50	**9.93**	10.18	9.47	**9.82**	10.27	9.49	**9.88**
N_{11}	0.1311	0.1240	**0.1276**	0.1389	0.1284	**0.1337**	0.1350	0.1262	**0.1306**	0.0877	0.0869	**0.0873**	0.0909	0.0858	**0.0883**	0.0893	0.0864	**0.0878**	15.34	15.22	**15.28**	15.66	15.53	**15.59**	15.50	15.37	**15.43**
N_{12}	0.0841	0.0945	**0.0893**	0.0934	0.0989	**0.0962**	0.0888	0.0967	**0.0927**	0.0808	0.0647	**0.0727**	0.0825	0.0630	**0.0727**	0.0816	0.0638	**0.0727**	12.68	9.56	**11.12**	12.67	9.54	**11.10**	12.67	9.55	**11.11**
N_{13}	0.1020	0.0748	**0.0884**	0.0837	0.0842	**0.0840**	0.0929	0.0795	**0.0862**	0.0568	0.0567	**0.0567**	0.0591	0.0603	**0.0597**	0.0580	0.0585	**0.0582**	9.95	8.37	**9.16**	9.96	8.71	**9.33**	9.95	8.54	**9.25**
N_{14}	0.0852	0.0913	**0.0883**	0.1076	0.0939	**0.1007**	0.0964	0.0926	**0.0945**	0.0784	0.0763	**0.0774**	0.0804	0.0760	**0.0782**	0.0794	0.0761	**0.0778**	10.05	9.58	**9.82**	10.03	9.83	**9.93**	10.04	9.70	**9.87**
N_{15}	0.0968	0.0913	**0.0941**	0.1166	0.0835	**0.1000**	0.1067	0.0874	**0.0970**	0.0675	0.0701	**0.0688**	0.0838	0.0703	**0.0771**	0.0756	0.0702	**0.0729**	14.65	10.88	**12.77**	12.70	11.18	**11.94**	13.68	11.03	**12.35**
N_{16}	0.1219	0.1253	**0.1236**	0.1221	0.1313	**0.1267**	0.1220	0.1283	**0.1251**	0.0851	0.0828	**0.0840**	0.0844	0.0861	**0.0853**	0.0848	0.0845	**0.0846**	15.17	14.78	**14.97**	15.47	14.17	**14.82**	15.32	14.48	**14.90**
MEAN	**0.1062**	**0.1019**		**0.1143**	**0.1045**		**0.1103**	**0.1032**		**0.0775**	**0.0754**		**0.0784**	**0.0750**		**0.0780**	**0.0752**		**12.21**	**11.02**		**12.38**	**11.08**		**12.30**	**11.05**	
	S.Em ±	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**		**S.Em ±**	**C.D at 5%**	
Varieties (V)	0.0009	**NS**		0.0027	**NS**		0.0017	**NS**		0.0014	**NS**		0.0010	**NS**		0.0011	**NS**		0.16	**0.49**		0.08	**0.24**		0.09	**0.29**	
Nutrients (N)	0.0040	**0.0114**		0.0050	**0.0142**		0.0033	**0.0094**		0.0038	**0.0107**		0.0026	**0.0073**		0.0029	**0.0081**		0.36	**1.04**		0.35	**1.00**		0.28	**0.79**	
N at same V	0.0057	**NS**		0.0071	**NS**		0.0047	**NS**		0.0054	**NS**		0.0037	**NS**		0.0040	**NS**		0.51	**1.47**		0.50	**1.41**		0.39	**1.12**	
Vat same or different N	0.0036	**NS**		0.0104	**NS**		0.0067	**NS**		0.0055	**NS**		0.0040	**NS**		0.0042	**NS**		0.63	**1.81**		0.33	**0.94**		0.38	**1.07**	

The interaction effect significantly higher number of spikelets per plant (104.62) was recorded in Vallabh Isabgol-1 supplied with N_{11} (75 % RD of FYM +75 % RD of NPK + *Azospirillum* + *PSB* + $ZnSo_4$ + $FeSo_4$) which was on par with V_1N_4 (103.44) followed by V_1N_6 (103.00), V_1N_4 (102.88) and V_1N_{16} (102.62). The lower spikelets per plant (59.34) was recorded V_1N_{13} during in pooled data.

The interaction effect significantly higher spike length (4.31 cm) was recorded with V_1 supplied with N_{11} (75 % RD of FYM +75 % of RD NPK + *Azospirillum* + *PSB* + $ZnSo_4$ + $FeSo_4$) which was on par with V_1N_4 (4.24 cm), V_1N_{16} (4.10 cm), V_2N_6 (4.12 cm), V_1N_4 (4.24 cm), V_1N_6 (4.03 cm). Further lower spike length (2.85 cm) was recorded with V_1N_{13} observed in pooled data.

Seed yield was significantly higher (103.60q ha^{-1}) was recorded in N_{11} supplied with 75 % RD of FYM + 75% RD of NPK + *Azospirillum* + *PSB* + $ZnSO_4$ + $FeSO_4$, which was on par with N_{16} (102.15q ha^{-1}), N_4 (103.16q ha^{-1}) and N_6 (102.07q ha^{-1}). The lower seed yield (59.88q ha^{-1}) was recorded in N_{13} supplied with 50% RD of FYM + 50% RD of NPK + *Azatobacter* during pooled data respectively. Similar trend was observed in pooled data. Phosphate dissolution and in the biosynthesis of bio-active in soil. The biofertilizers help in fixation of atmospheric nitrogen, better root proliferation, better availability and absorption of nutrients by the plants, which might have resulted in better growth in plant further N P K nutrients available form would attributed to more uptake of nutrients in faster rate in plant, *PSB* helps in reducing phosphorus fixation by its chelating effect and also solubilized the fixed phosphorus accelerated increase in growth of parameters towards reproductive parameters with accelerating tillers, dry matter production and increase towards yield attributing characters *viz*. number of seeds per spike and more, ultimately all these growth and reproductive yield attributes helped to increase seed yield, Similar findings observed by Repsiene (2001), Yadav *et al.,* (2003), Nadim *et al.,* (2011), Singh *et al.,* (2011), Tripati *et al.,* (2013), Choudhary *et al.,* (2014), Nadukeri *et al.,* (2014) and Shivran *et al.,* (2015).

In interaction effect significantly higher seed yield (103.60q ha^{-1}) was recorded in Vallabh Isabgol-1 supplied of N_{11} (75 % RD of FYM + 75% of RD NPK + *Azospirillum* + *PSB* + $ZnSO_4$ + $FeSO_4$), which was on par with V_2N_{11} (102.59q ha^{-1}) followed by V_1N_{16} (101.67 q ha^{-1}) followed by V_1N_6 (103.00q ha^{-1}) and V_2N_4 (101.14q ha^{-1}). The lower seed yield (74.27q ha^{-1}) was recorded in V_2N_{13} during pooled data respectively. Similar trend was observed in pooled data. This increased yield parameters due to use of improved variety because of genotypic character and increased the growth parameters conversion towards yield parameters with integrated use of chemical fertilizer, manures like FYM enhances the uptake of N, P and K by process releasing humus forming microbes. *Azotobactor* has nitrogen fixing potential as *Nitrogenase* activity of rhizosphere in soils by releasing some growth regulators IAA, results in the production of more vegetative growth parameters conversion towards physiological then reproductive. This relationship helped to increase the yield attributes, this leads to increase the straw yield and biological yield of Isabgol ultimately, these characters had positive beneficial effect towards higher seed yield same findings revealed by Hindiholi *et al.,* (2006), Chaudhary and Shivran *et al.,* (2009), Saxena and Rao (2000), Shivran *et al.,* (2015) and Shivran *et al.,* (2016).

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