Original Research Article

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

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ABSTRACT

Keywords

Vallabh Isabgol-1 and Gujarat Isabgol-2, Varieties, INM treatments, varieties with INM, Growth, Yield.

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The field research was conducted to evaluate the performance of growth parameters of two Isabgol varieties 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. Among the two Isabgol varieties grown in northern dry zone of Karnataka, analysis of both years with pooled data exhibited higher value was recorded in Vallabh Isabgol-1 in growth parameters viz., 50% early seed germination (5.38), plant height (36.85cm), number of leaves per plant (46.24), number of tillers per plant (10.40), leaf area index per plant (33.18 cm²) and seed yield (12.30 q ha⁻¹) as compared to Gujarat Isabgol-2 (11.05 kg ha⁻¹). Whereas the higher values with INM treatments with respect to plant growth parameters were observed in Viz. N₁₁-75 % 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) + ZnSO₄ (15 kg ha⁻¹) + FeSO₄ (7.5 kg ha⁻¹) viz., higher plant height (36.85), number of tillers per plant (13.94). less number of days taken for 50% seed germination (4.43%), higher values for interaction effect on growth parameters were recorded in V₁N₁₁ viz., higher plant height (37.39), number of tillers per plant (10.40), leaf area index (2.74), seed yield (12.30 q ha⁻¹).

Introduction

It is an annual herb grown during the *rabi* season, seed coat is known as Isabgol husk under trade. The swelling property of the seed coat or husk after absorption of water is used in medicine against constipation and

gastrointestinal disorders; it is used in food industries for the preparation of ice creams, creams, candy etc.

India is the only country producing maximum produce of Isabgol 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 Madhya 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.

In Karnataka, Isabgol cultivation 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 makeup and its potential, then response to climatic condition of this 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 clay 52.20 bulk density 1.25, EC 0.24 dS m⁻¹ and pH 8.22 (alkaline in reaction) with organic carbon 1.63 and available 268.02, 34.80, 273.69 NPK kg ha⁻¹.

The source of seed collection was DMAPR Anandh Gujarat i.e. Vallabh Isabgol-1 (V₁) and Gujarat Isabgol-2 (V₂). Seed were sown in 18 November 2015 and 2016 with gross plot size of 3.6 m x 1.5 m = 5.40 m² in split plot design in sixteen INM sub treatments with three replications as subplot listed below.

N₁ -RDF FYM (10 t ha⁻¹) + RDF NPK (50:25:30 kg ha⁻¹)

N₂-RDF FYM (10 t ha⁻¹) + RDF NPK (50:25:30 kg ha⁻¹) + ZnSO₄ (15 kg ha⁻¹)

N₃-RDF FYM (10 t ha⁻¹) + RDF NPK (50:25:30 kg ha⁻¹) + FeSO₄ (7.5 kg ha⁻¹)

N₄-RDF FYM (10 t ha⁻¹) + RDF NPK (50:25:30 kg ha⁻¹) + FeSO₄ (7.5 kg ha⁻¹) + ZnSO₄ (15 kg ha⁻¹)

N₅-Vermicompost (1t ha⁻¹) + RDF NPK (50:25:30 kg ha⁻¹)

N₆-Vermicompost (1t ha⁻¹) + 50% RDF NPK (50:25:30 kg ha⁻¹) + *Azospirillum* (5kg ha⁻¹) + *Azotobacter* (5kg ha⁻¹)

N₇-75% RD FYM (7.5 t ha⁻¹) + 75% RDF NPK (37.5:18.75:22.50 kg ha⁻¹)

N₈-75% RD FYM (7.5 t ha⁻¹) + 75% RDF NPK (37.5:18.75:22.50 kg ha⁻¹) + *Azotobacter* (5kg ha⁻¹)

N₉-75% RD FYM (7.5 t ha⁻¹) + 75% RDF NPK (37.5:18.75:22.50 kg ha⁻¹) + *Azospirillum* (5kg ha⁻¹)

N₁₀-75% RD FYM (7.5 t ha⁻¹) + 75% RDF NPK (37.5:18.75:22.50 kg ha⁻¹) + *PSB* (3kg ha⁻¹)

N₁₁-75% 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) + ZnSO₄ (15kg ha⁻¹) + FeSO₄ (7.5 kg ha⁻¹)

N₁₂-50% RDF FYM (5t ha⁻¹) + 50% RDF NPK (25:12.5:15 NPK kg ha⁻¹)

N₁₃-50% RD FYM (5t ha⁻¹) + 50% RDF NPK (25:12.5:15 kg ha⁻¹) + *Azotobacter* (5kg ha⁻¹)

N₁₄-50% RDF FYM (5t ha⁻¹) + 50% RDF NPK (25:12.5:15 kg ha⁻¹) + *Azospirillum* (5kg ha⁻¹)

N₁₅-50% RD FYM (5t ha⁻¹) + 50% RDF NPK (25:12.5:15 kg ha⁻¹) + *PSB* (3kg ha⁻¹)

N₁₆-50% 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) + Znso₄ (15kg ha⁻¹) + FeSO₄ (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 ZnSO₄ 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 crop requirement with the help of sprinkler.

Five plants were selected randomly in each plot, number of days taken for 50 per cent seed germination, plant height (cm) and number of tillers per plant and seed yield (kg plot⁻¹) and later calculated it as an seed yield (q ha⁻¹) were analysis the mean values of all the observations were worked out.

Results and Discussion

At harvest stage growth parameters were significantly higher viz., early 50% of seed germination (5.19, 5.57 and 5.38), plant height (33.07, 33.28 & 36.60cm), number of leaves per plant (46.01, 46.48 & 46.24), tillers per plant (10.30, 10.49 & 10.40), leaf area index (2.68, 2.81, & 2.74) and seed yield (12.21, 12.38 & 12.40q ha⁻¹) during 2015, 2016 and pooled data respectively, may be due to higher quantity of FYM application and bio fertilizers treatment resulting in to early seed germination. Similar findings also reported by Dubey *et al.*, (2009) and Ghaderi-Far *et al.*, (2012). This results due to varietal

performance to different agroclimatic conditions and genetical characteristics of particular variety and their difference in genotypic factor and adaptability of particular variety to soil and climatic conditions and the increased number of leaves, leaf area and number of tillers helped in better synthesis of carbohydrates and their utilization for build up of new cells, apart from better absorption of nutrients resulting in increased dry matter production were reported by several workers (Kumar *et al.*, 2009, Shirvan *et al.*, 2016a and Tyagi *et al.*, 2016). and more number of days taken for 50% seed germination (7.21, 7.44 and 7.32), lowest plant height (32.52, 32.11 & 32.31 cm), number of leaves (45.67, 45.63 & 45.65), number of tillers per plant (10.27, 10.43 & 10.35), leaf area index (2.56, 2.72 & 2.74) and seed yield (11.02, 11.08 & 11.05 q ha⁻¹) during 2015, 2016 respectively and pooled data as compared to Gujarat Isabgol-2.

The seed germination was significantly influenced by integrated nutrient management with application of 75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + ZnSO₄ + FeSO₄ (N₁₁)(4.50) which was on par with N₁₁(4.50), N₄(4.70) and N₆(5.09), shown early seed germination as compared to all other treatments.

This was influence of favourable soil conditions (pH 8.25, Electric conductivity 0.27 and organic carbon 1.89) with higher quantity of FYM application and bio fertilizers treatment resulting in to early seed germination. Similar findings also reported by Dubey *et al.*, (2009) and Ghaderi-Far *et al.*, (2012) observed early seed germination was because of alkaline pH (7-9) with less soil and air temperature (20⁰ C). Further, the maximum EC was recorded with application of *PSB* found to be beneficial in early 50 % germination seed vigour by release of growth promoting substances (Sharma *et al.*, 2007).

Significantly higher plant height at harvest stage in pooled analysis were presented 36.85 cm was recorded in N₁₁ (75 % RDF FYM + 75 % RDF NPK + *Azospirillum* + *PSB* + ZnSO₄ + FeSO₄), which were on par with N₆ (Vermicompost + 50 % RDF NPK + *Azospirillum* + *Azotobacter*) (36.85) and N₄ (RDF FYM + RDF NPK + ZnSO₄ + FeSO₄) (35.75), N₁₆ (50 % RDF FYM + 75 % RDF NPK + *Azospirillum* + *PSB* + ZnSO₄ + FeSO₄), (36.42 cm) with the best treatment N₁₁ respectively. Further lower plant height (29.55 cm) was recorded in N₁₃ (50 % RDF FYM + 50 % RD of NPK + *Azotobacter*) during pooled data, which could be attributed to adequate and balanced nutrients supply by use of organic manures helps faster rate of inorganic nutrients taken by plants towards production of bio-active substances which are having similar effect as that of growth regulators further increased plant growth parameters.

The number of leaves per plant was significantly influenced by integrated nutrient management at harvest stage the higher number of leaves per plant (55.50) was recorded in N₁₁, which was on par with N₄ (54.29), N₆ (54.24), and N₁₆ (54.06). Further the lower number of leaves per plant was recorded in N₁₃ (37.80). This is because of combined application of nutrients resulted creation of favourable environment for uptake of nutrients for plants by use organic and inorganic nutrients along with *Azospirillum* and *PSB* around rhizosphere which attributed to the enhanced the availability nutrients at appropriate time leads to the production of growth promoting substances, further that might have caused cell elongation and multiplication then to increase in the chlorophyll content of leaves resulted in increased synthesis of carbohydrates Yadav *et al.*, (2003).

The significantly higher number of tillers per plant at all the stages of crop growth, at harvest (13.94) was recorded in N₁₁ which was on par with N₄ (13.29), N₁₆ (13.27) and N₆ (13.20). The significantly lower number of tillers per plant was recorded in N₁₃ (8.48). This has been the consequence as a result of higher nutrient availability with application of organic manure (FYM, VC and biofertilizers) along with inorganic fertilizers which had profound influence in mobilizing the nutrients from the unavailable form of nutrients to available source and also enhanced improvement of soil physical, chemical and biological properties. The micro nutrient zinc application along with organics it acts as a component of carbonic anhydrase, as well as several dehydrogenases and required for auxin production which in turn enhance plant growth. Iron was necessary for the biosynthesis of chlorophyll and cytochrome, leading to increase in photosynthesis processes, respiration, other biochemical physiological activities of the plants. Similar results observed by Salmasi *et al.*, (2012) and Tripathi *et al.*, (2013).

The significantly higher leaf area index at harvest stage (3.43) was recorded in N₁₁ (75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + ZnSO₄ + FeSO₄) which was on par with N₁₆ (3.34), N₆ (3.31), N₄ (3.22) and further lower LAI (2.26) was recorded in N₁₃.

This might be due to the production of more number of leaves and green leaf surface leads to in the greater interceptions of light radiation. INM then have resulted increased plant height, tillers per plant results to maximum variation in growth characters then decrease in LAI towards maturity stage findings reported by Patel and Saravanan (2010).

In INM effect significantly higher seed yield (15.43 q ha^{-1}) was recorded in supplied of N_{11} (75 % RD of FYM + 75% of RD NPK + *Azospirillum* + *PSB* + ZnSO_4 + FeSO_4), which was on par with N_4 (15.12 q ha^{-1}), N_{16} (14.90 q ha^{-1}), N_6 (14.83 q ha^{-1}). The lower seed yield N_{13} (9.25 q ha^{-1}). The increased seed yield consequence with application of balanced nutrient RD of FYM 75 % + RD of NPK micro nutrients mixed with bio fertilizers like *azospirillum* mechanism through 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 which accelerating tillers, dry matter production and increase towards yield attributing characters viz. number of seeds per spike and more, ultimately all these growth parameters leads to increase seed yield, Similar findings observed by Repsiene (2001), Yadav *et al.*, (2003), Nadim *et al.*, (2011), Singh *et al.*, (2011), Tripathi *et al.*, (2013), Choudhary *et al.*, (2014), Nadukeri *et al.*, (2014) and Shivran *et al.*, (2015).

Interaction effect

Significantly higher plant height at harvest stage (37.39 cm) was recorded with Vallabh Isabgol-1 supplied with 75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + ZnSO_4 + FeSO_4 (N_{11}), which was on par with V_1N_{16} (36.60 cm), V_1N_6 (36.57cm), V_2N_{11} (36.32), V_2N_{16} (36.23), V_1N_4 (35.86). The lower plant height (28.66cm) was recorded in V_1N_{13} during the pooled data.

The number of leaves per plant was significantly at harvest stage of crop higher number leaves per plant (55.87) was recorded with Vallabh Isabgol-1 supplied with 75 % RD of FYM + 75 % RD of NPK + *Azospirillum* + *PSB* + ZnSO_4 + FeSO_4 (V_1N_{11}) which was on par with V_2N_{11} (55.13), V_1N_6 (54.54), V_2N_{16} (54.49) and V_1N_4 (54.48), V_1N_{16} (53.63), Further the lowest number of leaves per plant was recorded in V_1N_{13} (37.40) during the pooled data.

The interaction effect at harvest stage significantly higher number of tillers per plant (14.41) was recorded in (V_1N_{11}) Vallabh Isabgol-1, supplied with (75 % RD of FYM + RD of NPK + *Azospirillum* + *PSB* + ZnSO_4 + FeSO_4) which was on par with V_2N_{16} (13.87) followed by V_1N_6 (13.17), V_1N_4 (12.97) where as minimum number of tillers per plant (8.08) was recorded in V_1N_{13} during the pooled data. due to Vallabh Isabgol-1 variety and their performance under the agroclimatic condition with application above 75% RD organic and inorganic NPK fertilizers along secondary nutrients, biofertilizers combined application might resulted plants to more nutrients utilization for plant growth towards production of bio-active substances in soil micro flora, combined use of *Azotobacter* in soil it acts like growth regulators effects supports the hypothesis through the production of phytohormones, which stimulate root growth in Isabgol increased due to synthesis of carbohydrates, further utilized in building up of new cells towards the production of higher plant height and number of leaves increased tillers per plant which had positive effect towards higher growth parameters plant height, number of leaves, LAI and tiller per plant. Similar results are conformed by Yadav *et al.*, (2003), Venkatesh (2007), Nadim *et al.*, (2011), Mirshekari and Forouzandeh (2015) and Shivran *et al.*, (2016 b).

Table.1 Growth parameters on plant height (cm), number of leaves per plant and number of tillers per plant as influenced by Isabgol varieties and integrated nutrient management

Varieties	Number of day 50per cent seed germination									plant height (cm) at harvest									Number of leaves per plant at harvest								
Nutrients	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	5.86	6.25	6.05	6.20	7.71	6.95	6.03	6.98	6.50	31.48	30.66	31.07	32.05	30.87	31.46	31.77	30.76	31.27	46.51	49.00	47.76	47.67	49.00	48.33	47.09	49.00	48.04
N ₂	5.89	6.34	6.12	5.76	7.24	6.50	5.83	6.79	6.31	32.94	31.20	32.07	31.87	31.47	31.67	32.40	31.34	31.87	44.35	48.73	46.54	45.13	48.73	46.93	44.74	48.73	46.74
N ₃	4.82	5.15	4.99	5.59	6.92	6.26	5.21	6.04	5.62	30.92	29.89	30.40	31.07	30.67	30.87	30.99	30.28	30.64	44.33	48.73	46.53	45.00	48.73	46.87	44.67	48.73	46.70
N ₄	4.35	4.81	4.58	4.81	4.85	4.83	4.58	4.83	4.70	35.93	35.47	35.70	35.78	35.80	35.79	35.86	35.64	35.75	53.27	54.93	54.10	55.70	53.27	54.48	54.48	54.10	54.29
N ₅	4.27	5.49	4.88	5.29	6.67	5.98	4.78	6.08	5.43	32.36	34.00	33.18	31.38	31.40	31.39	31.87	32.70	32.29	44.65	49.53	47.09	45.87	50.20	48.03	45.26	49.87	47.56
N ₆	4.40	4.90	4.65	5.76	5.28	5.52	5.08	5.09	5.09	36.68	34.92	35.80	36.47	36.23	36.35	36.57	35.58	36.07	54.00	54.47	54.24	55.08	53.41	54.25	54.54	53.94	54.24
N ₇	5.82	6.63	6.22	5.84	7.23	6.54	5.83	6.93	6.38	33.33	31.40	32.36	32.53	30.90	31.72	32.93	31.15	32.04	46.13	39.33	42.73	40.47	39.33	39.90	43.30	39.33	41.32
N ₈	5.64	6.16	5.90	5.65	6.62	6.14	5.65	6.39	6.02	33.01	31.01	32.01	33.37	30.60	31.98	33.19	30.80	32.00	44.27	38.13	41.20	43.93	38.13	41.03	44.10	38.13	41.12
N ₉	5.45	6.11	5.78	5.64	7.46	6.55	5.55	6.78	6.16	33.97	29.80	31.89	34.57	30.33	32.45	34.27	30.07	32.17	39.80	36.00	37.90	39.80	36.00	37.90	39.80	36.00	37.90
N ₁₀	5.52	5.91	5.71	5.20	6.54	5.87	5.36	6.23	5.79	31.71	33.31	32.51	34.53	30.13	32.33	33.12	31.72	32.42	41.67	36.20	38.93	41.67	36.20	38.93	41.67	36.20	38.93
N ₁₁	4.21	4.31	4.26	4.65	4.84	4.75	4.43	4.58	4.50	37.52	35.87	36.69	37.27	36.77	37.02	37.39	36.32	36.85	55.20	54.13	54.67	56.53	56.13	56.33	55.87	55.13	55.50
N ₁₂	5.24	6.59	5.91	5.64	6.34	5.99	5.44	6.47	5.95	31.10	30.84	30.97	31.60	32.07	31.83	31.35	31.45	31.40	39.73	39.15	39.44	40.73	37.47	39.10	40.23	38.31	39.27
N ₁₃	6.94	7.48	7.21	7.51	7.36	7.44	7.22	7.42	7.32	27.71	32.47	30.09	29.60	28.40	29.00	28.66	30.44	29.55	36.07	37.53	36.80	38.73	38.87	38.80	37.40	38.20	37.80
N ₁₄	5.33	6.19	5.76	5.40	6.94	6.17	5.37	6.57	5.97	32.37	31.76	32.07	32.13	32.27	32.20	32.25	32.02	32.13	45.00	43.93	44.47	45.00	43.27	44.13	45.00	43.60	44.30
N ₁₅	4.97	5.10	5.04	5.18	6.80	5.99	5.08	5.95	5.51	31.87	31.53	31.70	31.37	29.53	30.45	31.62	30.53	31.07	48.13	46.47	47.30	48.13	46.80	47.47	48.13	46.63	47.38
N ₁₆	4.35	4.87	4.61	4.95	5.48	5.22	4.65	5.18	4.91	36.27	36.12	36.20	36.93	36.33	36.63	36.60	36.23	36.42	53.07	54.38	53.72	54.20	54.60	54.40	53.63	54.49	54.06
MEAN	5.19	5.77		5.57	6.52		5.38	6.14		33.07	32.52		33.28	32.11		33.18	32.31		46.01	45.67		46.48	45.63		46.24	45.65	
	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)	0.01	0.03		0.12	0.39		0.07	0.22		0.09	NS		0.14	0.44		0.10	0.36		0.042	0.52		0.109	0.67		0.049	0.14	
Nutrients (N)	0.10	0.20		0.32	0.92		0.17	0.49		0.63	1.80		0.47	1.33		0.46	1.33		1.070	3.03		1.044	2.95		0.926	2.62	
N at same V	0.25	NS		0.46	NS		0.24	NS		0.90	2.55		0.66	1.88		0.66	1.88		1.513	4.28		1.476	4.17		1.309	3.70	
Vat same or different N	0.21	NS		0.50	NS		0.28	NS		0.43	1.24		0.58	1.64		0.42	1.19		0.412	1.16		0.562	1.59		0.379	1.07	

Table.2 Growth parameters on leaf area index, tillers per plant and seed yield (q per ha) as influenced by Isabgol varieties and integrated nutrient management

Varieties	leaf area index at harvest									tillers per plant									seed yield (q per ha)								
	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	2.51	2.37	2.44	2.53	2.41	2.47	2.52	2.39	2.45	9.60	9.02	9.31	9.80	9.93	9.87	9.70	9.48	9.59	12.05	9.43	10.74	12.93	9.62	11.27	12.49	9.52	11.01
N ₂	2.65	2.20	2.42	2.80	2.37	2.59	2.72	2.29	2.51	9.75	9.21	9.48	9.80	9.88	9.84	9.78	9.54	9.66	12.51	9.49	11.00	13.22	9.80	11.51	12.86	9.65	11.26
N ₃	2.66	2.59	2.62	2.80	2.66	2.73	2.73	2.62	2.68	9.15	9.05	9.10	9.73	9.63	9.68	9.44	9.34	9.39	11.79	11.85	11.82	12.43	12.14	12.28	12.11	11.99	12.05
N ₄	3.28	3.10	3.19	3.31	3.17	3.24	3.30	3.14	3.22	12.17	13.82	12.99	13.78	13.39	13.58	12.97	13.60	13.29	14.84	14.86	14.85	15.55	15.22	15.39	15.19	15.04	15.12
N ₅	2.46	2.51	2.48	2.54	2.61	2.58	2.50	2.56	2.53	9.81	9.98	9.90	9.67	9.47	9.57	9.74	9.73	9.73	10.56	10.49	10.53	10.89	10.58	10.73	10.72	10.54	10.63
N ₆	3.32	3.17	3.25	3.49	3.24	3.37	3.41	3.21	3.31	12.39	12.25	12.32	13.95	14.23	14.09	13.17	13.24	13.20	14.87	14.81	14.84	15.29	14.34	14.82	15.08	14.57	14.83
N ₇	2.52	2.26	2.39	2.69	2.34	2.52	2.61	2.30	2.46	9.64	9.52	9.58	9.83	9.30	9.57	9.74	9.41	9.57	10.33	9.00	9.66	10.80	9.14	9.97	10.56	9.07	9.82
N ₈	2.65	2.16	2.41	2.75	2.29	2.52	2.70	2.23	2.46	9.60	9.17	9.38	9.53	9.30	9.42	9.57	9.23	9.40	10.14	9.38	9.76	10.29	8.62	9.45	10.21	9.00	9.61
N ₉	2.32	2.36	2.34	2.44	2.48	2.46	2.38	2.42	2.40	9.54	9.32	9.43	9.47	8.81	9.14	9.50	9.07	9.28	10.10	9.16	9.63	10.03	9.37	9.70	10.06	9.27	9.67
N ₁₀	2.34	2.23	2.28	2.16	2.35	2.25	2.25	2.29	2.27	10.03	9.79	9.91	9.33	9.07	9.20	9.68	9.43	9.56	10.36	9.50	9.93	10.18	9.47	9.82	10.27	9.49	9.88
N ₁₁	3.38	3.35	3.36	3.64	3.34	3.49	3.51	3.34	3.43	13.96	13.03	13.50	14.85	13.91	14.38	14.41	13.47	13.94	15.34	15.22	15.28	15.66	15.53	15.59	15.50	15.37	15.43
N ₁₂	2.51	2.25	2.38	2.66	2.75	2.71	2.59	2.50	2.55	9.29	9.44	9.36	9.29	8.70	9.00	9.29	9.07	9.18	12.68	9.56	11.12	12.67	9.54	11.10	12.67	9.55	11.11
N ₁₃	2.15	1.91	2.03	2.31	2.68	2.50	2.23	2.29	2.26	8.03	8.76	8.40	8.13	9.00	8.57	8.08	8.88	8.48	9.95	8.37	9.16	9.96	8.71	9.33	9.95	8.54	9.25
N ₁₄	2.46	2.48	2.47	2.67	2.62	2.64	2.56	2.55	2.56	9.49	9.36	9.42	8.94	8.93	8.94	9.21	9.14	9.18	10.05	9.58	9.82	10.03	9.83	9.93	10.04	9.70	9.87
N ₁₅	2.34	2.79	2.56	2.67	2.85	2.76	2.51	2.82	2.66	9.95	9.34	9.65	8.94	8.77	8.85	9.44	9.06	9.25	14.65	10.88	12.77	12.70	11.18	11.94	13.68	11.03	12.35
N ₁₆	3.27	3.29	3.28	3.43	3.36	3.40	3.35	3.33	3.34	12.47	13.23	12.85	12.87	14.51	13.69	12.67	13.87	13.27	15.17	14.78	14.97	15.47	14.17	14.82	15.32	14.48	14.90
MEAN	2.68	2.56		2.81	2.72		2.74	2.64		10.30	10.27		10.49	10.43		10.40	10.35		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)	0.067	NS		0.046	NS		0.056	NS		0.03	NS		0.066	NS		0.042	NS		0.16	0.49		0.08	0.24		0.09	0.29	
Nutrients (N)	0.087	0.25		0.108	0.31		0.088	0.25		0.21	0.60		0.200	0.57		0.160	0.45		0.36	1.04		0.35	1.00		0.28	0.79	
N at same V	0.123	NS		0.153	NS		0.125	NS		0.29	0.84		0.282	0.80		0.226	0.64		0.51	1.47		0.50	1.41		0.39	1.12	
Vat same or different N	0.262	NS		0.181	NS		0.220	NS		0.13	0.39		0.265	0.75		0.174	0.49		0.63	1.81		0.33	0.94		0.38	1.07	

Interaction effect significantly higher seed yield (15.50 q ha⁻¹) was recorded in Vallabh Isabgol-1 supplied of N₁₁ (75 % RD of FYM + 75% of RD NPK + *Azospirillum* + PSB + ZnSO₄ + FeSO₄), which was on par with V₂N₁₁ (15.37 q ha⁻¹), V₁N₁₆ (15.32 q ha⁻¹), V₁N₄ (15.19 q ha⁻¹) and V₁N₆ (15.08 q ha⁻¹). The lower seed yield (8.54 q ha⁻¹) was recorded in V₂N₁₃ during 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, *Azotobacter* 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), Choudhary and Shivran *et al.*, (2009), Saxena and Rao (2009), Shivran *et al.*, (2015) and Shivran *et al.*, (2016a).

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