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Effect of different sowing methods and nutrient management on Indian bean var., GNIB-21 sown after rice

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Abstract
A field experiment was conducted in Indian bean under different sowing methods and nutrient management at Agriculture Experimental Station, Navsari Agricultural University, Paria, Gujarat, India during the *rabi* seasons (Nov. - Feb.) of 2019-20 to 2021-22. It comprised of three main plot treatments of different sowing methods viz., direct seeding in paddy stump/stubble, zero tillage sowing method, conventional sowing method (after obtaining sizeable tilth) and three sub plot treatment of nutrient management viz., RDF, biofertilizer seed treatment (Rhizobium + PSB) + RDF, novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering + RDF in split plot design with four replications. The results revealed that significantly higher number of pod $plant^{-1}$, number of seed pod^{-1}, seed and stover yield was recorded with conventional sowing method (after obtaining sizeable tilth) and it was at par with zero tillage sowing method. Among the nutrient management treatment, application of novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering with RDF recorded maximum number of pod $plant^{-1}$, number of seed pod^{-1}, seed and stover yield of indian bean.

Keywords: Indian bean, sowing methods, nutrient management, PSB

Introduction
Pulses are the cheapest source of dietary protein; valuable animal feed, also plays a key role in improving and sustaining soil productivity on account of biological nitrogen fixation and addition of huge amounts of organic matter. Pulses are integral part of the cropping system because these crops fit well in the crop rotation and crop mixture and are most suited diversifying crops in cropping systems. In India pulses are grown in an area of 29.15 million hectares with total production of 25.41 million tonnes with productivity of 853 kg/ha during the year 2017-18 (Anonymous, 2018a) [3]. While, in Gujarat these are grown over an area of 6.6 lakh hectares with an annual production of 6.81 million tonnes with the productivity of 1029 kg/ha during the year 2018-19 (Anonymous, 2019) [4].

Among the pulses, Indian bean (*Dolichos Lablab* L.) or dolichus bean or lablab bean or hyacinth bean is a native of India. It is commonly grown in almost all the states viz., Madhya Pradesh, Uttar Pradesh, Maharashtra, Arunachal Pradesh, Tamil Nadu and Gujarat. Besides India, it also grown throughout the tropical regions of Asia, Africa and America. It is commercially grown for pods used as vegetable and for dry seeds used as pulses, however, regional preferences are existed in the cultivation of Indian bean. For instance, green shelled seeds are mostly preferred in south India, whereas white pods are liked in eastern India. In north India plains people like green pods has its own importance as tender immature green pods, cooked as vegetable alone or with potatoes. Dry seeds are used for pulse purpose. The foliage of Indian bean is used as hay, silage and green manure.

In Gujarat, Indian bean is the most important crop particularly grown in Navsari, Surat and Valsad districts. In South Gujarat, it is highly grown during rabi season in field vacated by *kharif* crops like rice, maize and millets. In Gujarat, Indian bean was cultivated in an area of 8.1 lakh ha with production of 15.6 lakh MT and productivity of 871 kg/ha during the year 2014-15 (Anonymous, 2016) [2]. To increase the production of any crops, a proper management practice has very much importance.

Rice is major crop sown in *kharif* season in south Gujarat region followed by Indian bean. Tillage and other field preparations required to prepare the field for planting after rice

Cultivation cost around 20-30% of the total cost of cultivation of succeeding crop. Zero-tillage or no-tillage farming systems may be applied to save this cost. Such methods are seemed to be quite harder for obtaining better crop stand. But, through the use of proper seed treatment we may try to tackle this task. In this, biofertilizers treatment has shown good results for increasing germination and plant stand in many crops, but the effect of pseudostem sap is yet to test. Keeping these above points in view, the present investigation was undertaken to find out the Effect of different sowing methods and nutrient management on Indian bean var., GNIB-21 sown after Rice.

Materials and Methods

A field experiment was carried out at at Agriculture Experimental Station, Navsari Agricultural University, Paria, Gujarat, India during the *rabi* seasons (Nov. - Feb.) of 2019-20 to 2021-22. The soil in the test area is heavy black, alkaline in reaction (pH 7.74), has normal EC (0.40 S/m), high organic carbon content (1.10%), available nitrogen (234 kg ha^{-1}), phosphorus (59 kg ha^{-1}) and potassium (430 kg ha^{-1}). The experiment involved three main plot treatments comprising different sowing methods viz. direct seeding in paddy stump/stubble, zero tillage sowing method, conventional sowing method (after obtaining sizeable tilth) and three sub plot treatment of nutrient management viz., RDF, biofertilizer seed treatment (Rhizobium + PSB) + RDF, novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering + RDF. Experiment was conducted in split plot design with four replications in a fixed layout. Recommended package of practices were followed for growing indian bean cv. GNIB-21 during all the year. The crop was sown with spacing 45 × 15 cm in the month of October and harvested in the month of February during all the years. The recommended fertilizer dose were 25:50:00 N:P:K kg ha^{-1}, respectively. Full dose of P and K as basal and N in two splits i.e. 50% as basal and 50% at 30 DAS. Application of seed treatment of rhizobium, PSB and novel as per treatment at the time of sowing and 1% spray of novel at the time of flowering. The data on growth and yield attributing parameters of preceding *rabi* Indian bean were collected at various stages of the crop season, were analyzed with split plot design, respectively and then determined and statistically analyzed using the appropriate procedure (Panse and Sukhatme, 1967) [6]. The data collected from the experiment on various observations were subjected to pooled analysis as prescribed by Gomez and Gomez (1984) [5].

Result and discussion

All growth parameters of Indian bean viz., plant population, days to 50% flowering and days to maturity were observed no any significant influence due to use of various sowing methods and nutrient management (Table 1). However, plant height was showed significant effect of different treatments. In different sowing methods, significantly highest plant height (37.35 cm) was noted with treatment M_3 (Conventional sowing method) but in case of nutrient management, it was highest with treatment T_3 (Novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering + RDF) (35.96 cm). Conventional sowing method with seed treatment of PSB and Rhizobium biofertilizers help in root nodulation in leguminous crops results in nitrogen fixation that fulfil nitrogen requirement at later growth stages which reflected in improvement in the primary growth parameters resulted on improvement in the dry matter accumulation. Almost similar results were also observed by Ananth and Kumar (2018) [1].

Yield contributing characters viz., number of pods plant^{-1}, number of seeds pods^{-1}, seed and stover yield (kg ha^{-1}) found significant influence due to different sowing methods and nutrient management treatments (Table 2). On three year pooled basis, conventional sowing method (M_3) gave significantly more number of pods plant^{-1} (26.79), number of seeds pods^{-1} (4.34), seed (599.97 kg ha^{-1}) and stover yield (1048.36 kg ha^{-1}) found superior as compared to other treatments. It was at par with zero tillage sowing method (M_2). Among the nutrient management, application of Novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering with RDF recorded significantly maximum number of pods plant^{-1} (25.50), number of seeds pods^{-1} (4.35), seed (594.03 kg ha^{-1}) and stover yield (1038.44 kg ha^{-1}) as compared to other treatments and it was at par with application of biofertilizer seed treatment (Rhizobium + PSB) with RDF. This might be due to the favourable effect of treatment on plant because of easy availability of nutrients might have reflected in higher growth parameter and yield attributes ultimately resulted in higher yields. These results are in close vicinity with the findings of Patil *et al.* (2012) [7] in chickpea and Singhal *et al.* (2015) [8] in cowpea.

Table 1: Effect of different sowing methods and nutrient management on growth attributes of Indian bean (3 year pooled result)

Treatments	Plant height (cm)	Plant population	Days to 50% flowering	Days to maturity
Main plot (M)				
M_1	33.13	138639	48	135
M_2	34.65	135418	47	134
M_3	37.35	139950	47	133
S. Em ±	0.27	466.66	0.31	0.60
CD (*p*=0.05)	0.80	NS	NS	NS
Sub plot (T)				
T_1	33.75	138805	47	133
T_2	35.40	137325	47	131
T_3	35.96	137877	48	137
S. Em ±	0.07	126.83	0.10	0.20
CD (*p*=0.05)	0.20	NS	NS	NS
Interaction (M x T)				
CD (*p*=0.05)	NS	NS	NS	NS

Table 2: Effect of different sowing methods and nutrient management on yield and yield attributes of Indian bean (3 year pooled result)

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Main plot (M)				
M_1	21.76	3.87	479.59	853.34
M_2	24.77	4.21	552.60	969.75
M_3	26.79	4.34	599.97	1048.36
S. Em ±	0.20	0.027	4.05	8.01
CD (*p*=0.05)	0.60	0.077	12.03	23.80
Sub plot (T)				
T_1	22.52	3.92	513.25	895.44
T_2	25.30	4.15	524.89	937.58
T_3	25.50	4.35	594.03	1038.44
S. Em ±	0.064	0.010	1.23	1.99
CD (*p*=0.05)	0.18	0.029	3.49	5.64
Interaction (M x T)				
CD (*p*=0.05)	NS	NS	NS	NS

Conclusion

Based on the result of three year experiments it can be concluded that the treatment combination of conventional sowing method with novel seed treatment @ 10 ml kg^{-1} seed *fb* 1% spray at flowering + RDF recorded significantly highest values of growth parameter, yield attributes and yields.

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