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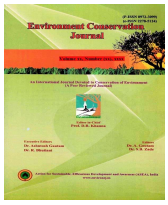

Response of organic black gram to botanical seed pelleting and row spacing

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ABSTRACT

The field trial was carried in *Zaid* season of 2021 at SHUATS Model of Organic Farm (SMOF), Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The objective was to study the growth and yield of Black gram as influenced by crop geometry and seed pelleting with botanicals under certified organic production system. The experiment was laid out in a randomized block design to study the effect of seed pelleting with leaf powders of three botanicals, *viz*., *Pongamia pinnata*, *Prosopis juliflora,* and *Albizia lebbeck,* and sown in three different row spacings of 20 cm, 30 cm, and 40 cm, on the growth and yield of black gram. The results revealed that black gram seeds pelleted with *Albizia* leaf powder and sown at row spacing of 30 cm reported maximum plant height (43 cm), dry weight (12.49 g/plant), number nodules per plant (27.50), seeds per pod (7.07), test weight (42.19 g), grain yield (872.96 kg/ha), and haulm yield (2511.11 kg/ha) which was significantly superior to other treatments.

Introduction

In India, black gram (*Vigna mungo* L.) is the third-most significant pulse crop. It is rich in protein (~27.75 %), which is about two third of the protein content of soybean, twice that of wheat and thrice that of rice (Kamani and Meera, 2021). Hence, a diet combining black gram and cereal grains forms a balanced amino acid diet.This crop is important in terms of sustaining soil fertility through improving soil physico-chemical properties. In 2020-21,India produced about 2.34 m t of urad annually from about 4.67 m ha of area, with an average productivity of 501kg per hectare (DACFW, 2021). Because the crop is mostly cultivated in rain-fed circumstances with poor management practices, as well as due to other physiological, biochemical, and intrinsic characteristics related to crop, the yield potential of black gram is extremely low. Several strategies have been introduced to boost the productivity of black gram. One of them is seed pelleting with botanicals, which helps to overcome the adverse environmental conditions. They also boost the emergence and enhances growth of seedling's root and shoot, thereby resulted in increased productivity. In addition, pelleting improves the water holding capacity of the soil in the rhizosphere and supply nutrients to the germinating seed (Srimathi *et al*., 2013). Nutrient applications to dry lands are troublesome; instead, pre-treating the seed with the nutrients will increase its viability and vigour, resulting in improved yield. In any crop, maintaining the ideal plant population is crucial for obtaining optimum yield from the crop. In black gram, optimum plant population can be achieved by adjusting inter- and intra-row spacing. The optimum spacing encourages both above and below ground plant growth, and also provides favourable environment to have maximal light interception during crop growth. This research study will provide insight on how seed pelleting

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and row spacing affect the development, output, and economics of black gram cultivation.

Material and Methods

The experiment was conducted during *Zaid*, 2021, in SMOF (SHIATS Model of Organic Farm), Department of Agronomy, Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj (U.P.). The experimental land was uniform in topography and soil texture was sandy loam with nearly neutral soil reaction (pH 7.1), medium organic carbon (0.58%), low available N (225 kg/ha), available phosphorous (19.50 kg/ha), and medium available potassium (129.7 kg/ha). The experiment was plotted in Randomized Block Design with ten treatments, consists of seed pelleting with three different botanical's powder (*Pongamia pinnata*, *Prosopis juliflora,* and *Albizia lebbeck*) and were sown at three different row spacings (20 cm, 30 cm, and 40 cm) and one control (non-pelleted seed sown at 35 cm row spacing) which were replicated thrice. The trial field was carefully ploughed, harrowed, and levelled. For nutrient supply, well decomposed farmyard manure is applied at the rate of 5 t/ha to fulfil the required amount of nutrients for the production of organic black gram. Seeds were sown after being pelleted with powdered botanicals as per the treatments. Seed pelleting refers to the coating of seeds with inert material just large enough to produce a globular unit to facilitate precision planting. The fresh leaves of three botanicals (*Pongamia pinnata*, *Prosopis juliflora,* and *Albizia lebbeck*) were collected, shade dried, powdered and sieved individually. The seeds were first coated with 10% maida solution (adhesive) and then rolled in leaf powder (200g/kg seeds) until a uniform coating has been done. Seeds were pelleted thoroughly, avoiding the formation of any lumps (Fig. 1). Seeds were dried under shade before sowing (Prakash *et al*., 2020).

Results and Discussion

Growth parameters

The experimental results for growth parameters (Table 1) of black gram recorded significantly highest plant height (43.00 cm) at 45 DAS in *Albizia* leaf powder pelleted seeds, sown at 30 cm row spacing and found statistically at par with T_3, T_6, T_7, T_9, and T_{10}. This outcome could be attributed to the improved metabolic activity in plumule and radicle cells of the seed induced by the micronutrients supplied by *Albizia* powder. This enables better nutrient absorption, initiating seedling growth, and, ultimately, stimulating rapid growth and increased plant height. The inert material improves natural water holding capacity and provides initial nutrients to emerging plantlets (Krishnasamy, 2003). Similar to this, optimal spacing assures the availability of resources for crop establishment and growth, increasing crop height. At 45 days after sowing significantly highest nodules in a plant (51.17) was recorded in seed pelleting with *Albizia* powder at 200g/kg seeds and sown at 30cm row spacing, which was on par to T_1 and T_6. This could be because of the optimum spacing available for the enhanced root proliferation and the favourable rhizosphere environment for nodule development brought up by the seeds pelleted with *Albizia* powder. At 45 DAS, the significantly highest dry weight per plant (12.49 g/plant) was recorded in seeds pelleted with *Albizia* powder at 200 g/kg seeds and sown at the line spacing of 30 cm. The embryo and other associated structures might have been activated by the physiologically active substances resulting in the absorption of more water due to cell wall elasticity and development of stronger and efficient root system which in turn favours the derivation of more nutrients thus enabling better growth of the plants (Prakash *et al*., 2020). The presence of bioactive compounds like auxins in the *Albizia* leaf powders aids seedling growth to reach the autotrophic stage and also create relatively more dry matter with an increase in vigour index. It might also be attributed to the increased growth of the plant (Narayanan *et al*., 2016). Wider plant spacing might have been the cause of the higher plant height and nodules per plant because it intercepted more photosynthetically active radiation. This led to vigorous plant growth, more branches and leaves, and more dry matter per plant (Murade *et al*., 2014).

Yield attributes and yield

The data pertaining to yield attributes (Table 2) reported that except seeds per pod, other yield attributes differed significantly with seed pelleting and varied row spacing. Seed pelleted with *Albizia* leaf powder and sown in lines 30 cm apart recorded higher pods in one plant (24.55), which was

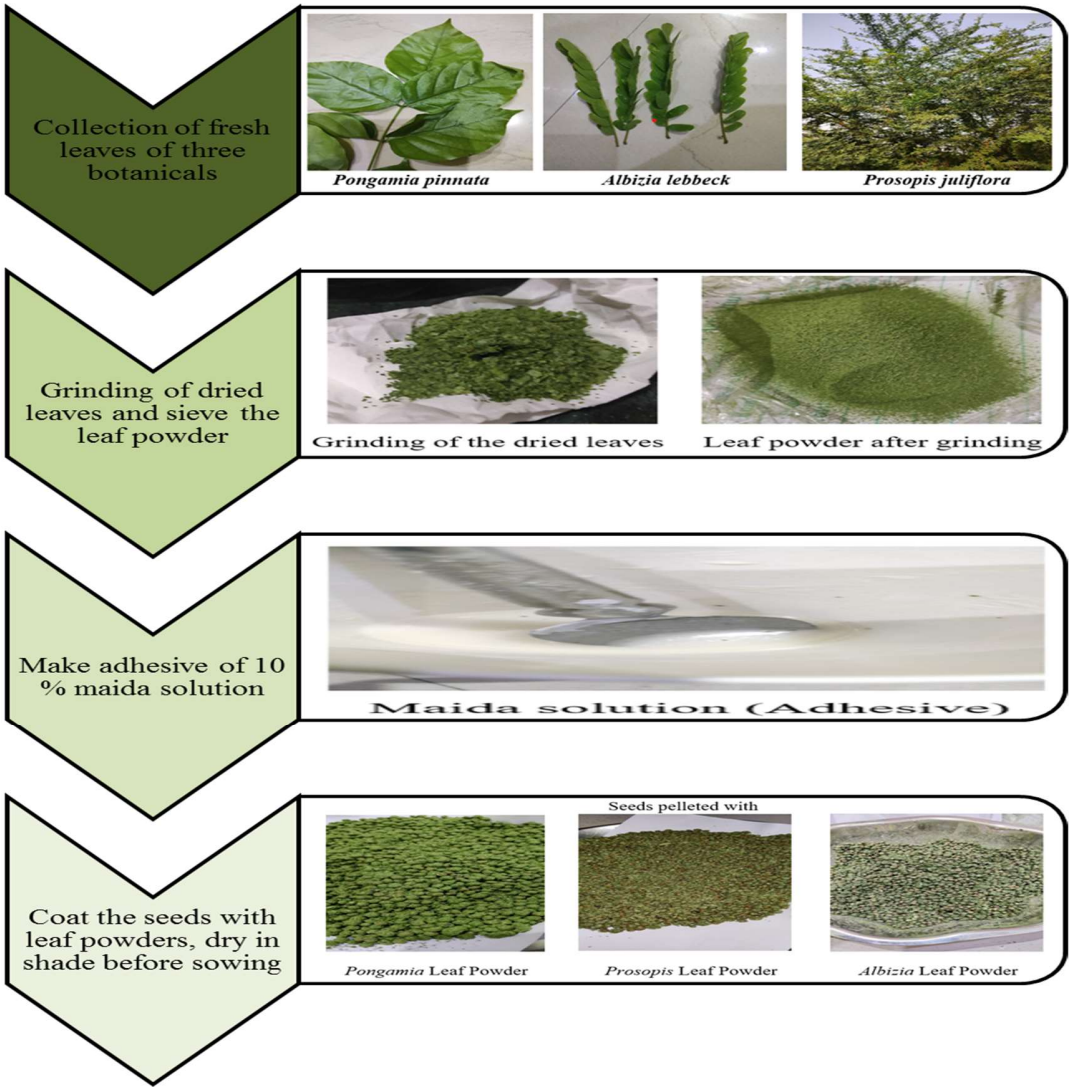

Figure 1: Process of seed pelleting with leaf powder of three botanicals

Table 1: Effect of organic seed pelleting and row spacing on the growth of Black gram

Treatments	At 45 DAS		
	Plant Height (cm)	Nodules/Plant (No.)	Dry Weight (g/plant)
1. Seed pelleting with *Pongamia* L.P. + 20 cm x 10 cm	30.60	50.67	10.66
2. Seed pelleting with *Pongamia* L.P. + 30 cm x 10 cm	28.82	37.83	11.78
3. Seed pelleting with *Pongamia* L.P. + 40 cm x 10 cm	40.47	41.17	12.23
4. Seed pelleting with *Prosopis* L.P. + 20 cm x 10 cm	29.90	38.33	11.89
5. Seed pelleting with *Prosopis* L.P. + 30 cm x 10 cm	32.83	39.17	9.85
6. Seed pelleting with *Prosopis* L.P. + 40 cm x 10 cm	34.98	48.33	11.28
7. Seed pelleting with *Albizia* L.P. + 20 cm x 10 cm	34.97	40.00	12.07
8. Seed pelleting with *Albizia* L.P. + 30 cm x 10 cm	43.00	51.17	12.49
9. Seed pelleting with *Albizia* L.P. + 40 cm x 10 cm	36.23	41.50	12.30
10. No seed pelleting + 35 cm x 10 cm (Control plot)	38.84	40.33	10.08
S. Em. (±)	2.71	2.56	0.06
C. D. (P = 0.05)	8.05	7.60	0.18

Table 2: Effect of organic seed pelleting and row spacing on yield attributes of black gram

Treatment	Pods/Plant (No.)	Seeds/Pod (No.)	Test Weight (g)
1. Seed pelleting with *Pongamia* L.P. + 20 cm x 10 cm	18.33	5.60	37.28
2. Seed pelleting with *Pongamia* L.P. + 30 cm x 10 cm	20.55	5.87	38.52
3. Seed pelleting with *Pongamia* L.P. + 40 cm x 10 cm	21.56	6.33	41.05
4. Seed pelleting with *Prosopis* L.P. + 20 cm x 10 cm	20.33	6.07	40.05
5. Seed pelleting with *Prosopis* L.P. + 30 cm x 10 cm	18.89	5.40	36.20
6. Seed pelleting with *Prosopis* L.P. + 40 cm x 10 cm	22.11	6.67	39.22
7. Seed pelleting with *Albizia* L.P. + 20 cm x 10 cm	21.78	6.73	39.68
8. Seed pelleting with *Albizia* L.P. + 30 cm x 10 cm	24.55	7.07	42.19
9. Seed pelleting with *Albizia* L.P. + 40 cm x 10 cm	22.11	6.87	40.92
10. No seed pelleting + 35 cm x 10 cm (Control plot)	21.56	6.53	38.24
S. Em. (±)	1.16	0.24	0.39
C. D. (P = 0.05)	-	0.71	1.16

Table 3: Effect of organic seed pelleting and row spacing on yield of black gram

Treatments	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
1. Seed pelleting with *Pongamia* L.P. + 20 cm x 10 cm	726.30	1497.78	32.65
2. Seed pelleting with *Pongamia* L.P. + 30 cm x 10 cm	751.48	1724.81	30.36
3. Seed pelleting with *Pongamia* L.P. + 40 cm x 10 cm	794.44	1911.11	29.38
4. Seed pelleting with *Prosopis* L.P. + 20 cm x 10 cm	773.70	1802.22	30.04
5. Seed pelleting with *Prosopis* L.P. + 30 cm x 10 cm	722.59	1428.15	33.60
6. Seed pelleting with *Prosopis* L.P. + 40 cm x 10 cm	801.11	2174.81	26.92
7. Seed pelleting with *Albizia* L.P. + 20 cm x 10 cm	848.52	2410.74	26.03
8. Seed pelleting with *Albizia* L.P. + 30 cm x 10 cm	872.96	2511.11	25.82
9. Seed pelleting with *Albizia* L.P. + 40 cm x 10 cm	852.22	2482.96	25.56
10. No seed pelleting + 35 cm x 10 cm (Control plot)	799.63	2119.26	27.39
S.Em. (±)	10.54	34.51	0.38
C. D. (P=0.05)	31.31	102.54	1.12

Table 4: Economics of different treatments on black gram

Treatments	Total cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C
1. Seed pelleting with *Pongamia* L.P. + 20 cm x 10 cm	36,450.00	89,466.20	53,016.20	1.45
2. Seed pelleting with *Pongamia* L.P. + 30 cm x 10 cm	36,450.00	94,562.00	58,112.00	1.59
3. Seed pelleting with *Pongamia* L.P. + 40 cm x 10 cm	36,450.00	76,859.20	40,409.20	1.11
4. Seed pelleting with *Prosopis* L.P. + 20 cm x 10 cm	36,450.00	78,297.90	41,847.90	1.15
5. Seed pelleting with *Prosopis* L.P. + 30 cm x 10 cm	36,450.00	90,550.50	54,10050	1.48
6. Seed pelleting with *Prosopis* L.P. + 40 cm x 10 cm	36,450.00	75,055.70	38,605.70	1.06
7. Seed pelleting with *Albizia* L.P. + 20 cm x 10 cm	36,450.00	82,723.80	46,273.80	1.27
8. Seed pelleting with *Albizia* L.P. + 30 cm x 10 cm	36,450.00	96,676.10	60,226.10	1.65
9. Seed pelleting with *Albizia* L.P. + 40 cm x 10 cm	36,450.00	89,419.30	52,969.30	1.45
10. No seed pelleting + 35 cm x 10 cm (Control plot)	36,450.00	79,105.30	42,655.30	1.17

statistically at par to all treatments. However, a significantly higher seeds in a pod (7.07) and test weight (42.19 g) were obtained in treatment 8. Higher number of pods in a plant, seeds in a pod, and test weight might have been possible as a result of the plants' improved photosynthetic processes, which were made possible by adequate light availability and the provision of balanced nutrients to crop. The grain (872.96 kg/ha) and haulm yield (2511.11 kg/ha) of *Albizia* leaf powder pelleted seeds, sown at 30 cm row spacing were significantly higher, whereas significantly higher harvest index (33.60%) was recorded in seed pelleted with *Prosopis* powder at 200 g/kg seeds and sown at the same spacing. The roots were able to uptake nutrients due to better availability of moisture and moderation of soil temperature for

proper growth and development of plants and ultimately the yield attributes. The plants showed vigorous growth with a stronger root system as a result of the seeds pelleted with *Albizia* leaf powder, which in turn helped the plants to assimilate required moisture and nutrients from soil and enabled increased growth and yield. Seed pelleting increased the photosynthetic rate due to higher nutrient uptake and efficient translocation of photosynthates from source to sink might be attributed for higher yield attributes (Alex *et al*., 2017).

Economics

Observations recorded for the economics of different treatments of black gram are given in Table 4. Maximum gross monetary return (INR 96,676.10 per ha), net monetary return (INR 60,226.10 per ha), and B:C (1.65) were recorded for seed pelleted with *Albizia* powder at 200 g/kg of seeds and sown at the spacing of 30 cm by 10 cm. These effects may be attributable to the treatment's improved expression of growth characteristics and yield qualities, which in turn contributed to higher returns.

Conclusion

It can be concluded that the black gram seeds pelleted with *Albizia lebbeck* leaf powder and sown at 30 cm x 10 cm spacing under organic farming was found to be the most effective treatment, as it enabled better nutrient absorption, initiated seedling growth, and, ultimately, stimulated rapid growth and increased productivity. It also fetched higher economic returns. This conclusion is based on the results of one season of experimentation; for a final recommendation to farmers, further experimentation is required.

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Conflict of interest

The authors declare that they have no conflict of interest.

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