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Pre-sowing Seed treatments of Chemical, Electric, Magnetic and Botanical Treatments on Plant Growth, Yield and Yield Attributing Traits of Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub] [Variety Pusanavbahar]

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A B S T R A C T

The experiment was carried out by in the postgraduate Seed Testing Laboratory and field, Department of Genetics and Plant Breeding, Sam Higgin bottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during Kharif season 2018-2019, to standardize the suitable pre-sowing seed treatment of Cluster bean (Pusanavbahar). Different concentration with different duration of pre-sowing seed treatments with control (Unhardened) were evaluated by screening 8 hour viz., Magnetic field (100mT for 45 min, 35 min and 25 min), Electric treatment (70 mA @10min and 20 mA @ 5min), Panchagavya (3% and 5% for 8hrs), Agniastra (3% and 5%for 8hrs), KNO_3 (3%,5% and 7% for 8hrs). It has been reported that all the pre-sowing seed treatments showed significant. The variance with the control, in field highest field emergence percentage and yield and yielding attributes in KNO_3 (5% for 8hrs) has performed the best results in field parameters like Field emergence percentage, Plant height 90 DAS, Days to 50% flowering, Number of clusters per plant, Number of pods per plant, Days to maturity, Pod weight per plant (g), Seed yield per plant (g), Seed yield per plot (g), Biological yield (g) and Harvest index (%) followed by Magnetic field (100 mT for 35 min) and Electric treatment (20mA for 5 min) and found to be lowest in control seeds. Hence seed treatment of Cluster bean seeds with KNO_3 5% is the best treatment compared to electric and other pre-sowing seed treatments.

Introduction

Cluster bean [*Cyamopsis tetragonaloba* (L.) Taub] Chromosome number (2n=14) belongs to the family Fabaceae. It is assumed to have developed from the African species Cyamopsis senegalensis. It is hardy and drought tolerant crop having deep root system which enables to utilize the available moisture more efficiently and offers to sustain under rainfed situation (Kherwat *et al.,* 2013). In India, Cluster bean mostly grown in Rajastan,

Haryana, Punjab, UttarPradesh and MadyaPradesh. Rajastan occupies first position in india both in area and production.

It accounts for almost 82.1 percent area and 70% production in India. Haryana and Gujarat has Second and Third position respectively. Rajastan has an area of 30 lakh hectare, Production of 15.46 lakh tones with a productivity of 515 kg/ha. (Anonymous 2013-14).Guar occupies an important role in Indian economy because of its industrial importance mainly due to the presence of gum in its endosperm (35 to 40 %). It had been grown since ancient era for various purposes viz., vegetable, green fodder, manure and feed. Green and tender pods of cluster bean are being used as a favourite vegetable in many parts of the counry. It is also grown as a forage crop (Ayub *et al.,* 2012). The pods of cluster bean are as rich in food value as that of French bean.

Cluster bean can be used for multiple purposes (vegetable, cattle feed/fodder or green manure). It is a good source of nutrition and its tender green pods are also a cheap source of nutrients. Further cluster bean meal and seed are used as high protein cattle feed (Rai and Dharmatti, 2013). It is mainly cultivated for guar gum production and for forage, whereas in South India it is being cultivated for vegetable purpose (Tripathy and Das, 2013).

Cluster bean has several health benefits in both vegetable and powder form (guar gum). Guar gum has also been shown to be useful in weight loss and diabetes treatment. Guar pods are rich in soluble dietary fibre and lowers blood cholesterol levels. Guar gu m is a common ingredient in fibre-rich drinks marketed as health drinks and weight-loss drinks. Low in calories, the cluster bean (guar) contains vitamin C, vitamin K, vitamin A, dietary fibre, folate, iron, manganese and

potassium. The vitamin K is important for maintaining strong bones and proper development of foetus. The nutritional values per 100 gm of raw cluster bean is one of the most important and potential vegetable cum industrial crop grown for its tender 2 pods for vegetable purpose and for endospermic gum (30-35%)(Kumar and Singh, 2002).

Cluster bean grown as forage as well for extraction of guar gum (galactomannan) which finds its utilization in food industry, a substitute of fat in human food, paper, pharmaceutical, petroleum and cosmetic industry (Sortino and Gresta, 2007). After gum extraction, the residue called guar meal is used a high protein concentrate for animals.

The intercropping of cereal forages with forage legumes such as cluster bean has been found effective in increasing not only forage yield but also the quality of mixed forage especially protein contents (Ahmad *et al.,* 2007).

Pre-sowing treatments of their seeds for ensuring their earlier, successful germination. This will help people to minimize their production cost of seedlings on a broad scale. A considerable body of evidences suggests that pre-sowing treatments strongly enhance the germination process (Hossain *et al.,* 2005). Seeds of many species do not germinate well unless they are exposed to certain conditions. This state of not germinating unless the required conditions are met is called dormancy.

In the natural environment the conditions may be exposure to fire or being eaten by animals. When seeds are eaten they are exposed to the hydrochloric acid in the stomach of the animal, and this breaks the dormancy without damaging the seed. Similar methods are used by man to treat seeds and break the dormancy of seeds he wishes to germinate.

Electro-magnetic treatment in whichexposure of seeds to electromagnetic fields is one of the safest and potential physical pre-sowing treatments to enhance the post germination development and crop stand (Florez *et al.,* 2007).

Materials and Methods

The Research work was carried out at experimental field during Kharif season 2019-2020. Department of Genetics and plant breeding, Naini Agricuulture Institute, Sam Higgin bottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The statistical designs were applied carried out with Randomised Block Design (RBD) With 13 treatments and 3 replications. Seed material consists of Cluster bean Pusanavbahar. The treatments were represented as T_0 – Control, T_1 – Magnetic Treatment (100 MT) @ 45 minutes, T_2 – Magnetic Treatment (100 MT) @ 35 minutes, T_3 – Magnetic Treatment (100 MT) @ 25 minutes, T_4 – Electric Treatment (70 mA) @ 10 minutes, T_5 – Electric Treatment (20 mA) @ 5 minutes, T_6 – Panchagavya @ 3%, T_7 – Panchagavya @ 5%, T_8 – Agniastra @ 3%, T_9 – Agniastra @ 5%, T_{10} – KNO_3 @ 3%, T_{11} – KNO_3 @ 5%, T_{12} – KNO_3 @ 7%.

Method of magnetic field

An electromagnetic field generator "Testron EM-20" with variable static magnetic field (SMF) strength (50 to 500 MT) with a gap of 5 cm between pole pieces was fabricated. A D.C. power supply (80V/10A) with continuously variable output current was used for the electromagnet.

A digital gauss meter model DGM-30 operating on the principle of Hall Effect monitored the field strength produced in the pole gap. The probe is made of Indium arsenide crystal and is encapsulated to a non-magnetic sheet of 5 mm x 4 mm x 1 mm and could measure 0-2 Tesla with full-scale range in increments of 5 MT. By regulating the current in the coils, desired strength of SMF was monitored, which was measured by a Gauss meter. The strength and duration was standardized for maximum enhancement of germination and vigour of seeds.

Method of electric field

To expose the seeds to electric field, an electric field generator was fabricated by using sodium chloride as electrolyte with copper (+) and zinc (-) electrodes. A battery of 24V DC was used as the power source for the electrolysis treatment of cluster bean seeds. The two electrodes were placed vertically inside the plastic tray parallel to each other. In the plastic tray seed material were placed in already prepared electrolyte solution lies below the level of electric cord connecting point. Electric power cods were connected with power supply unit in respective places. An electric current of DC 24 V was passed at required intensities for different duration as per the treatment through the seeds to serve electrotherapy treatment.

Seeds soaking in solution

After preparation of solution of Panchagavya, Agniastra and KNO_3, clusterbean seeds were soaked in required solution for 8 hrs at 25^0C temperature. Untreated seed is called as control. After 8hrs of soaking the solution were drained out from the beaker and pre-soaked were air dried to original weight. After seed treatments seed were sown in field for occurring field observation.

Design

Randomized Block Design (RBD) Panse and Sukhatme, (1967)with three replications. Observations on Field viz- Field emergence,

Plant height, and nodulation. The data was collected and statistically analyzed using ANOVA.

Results and Discussion

According to the findings, all the characteristics analyzed were influenced by the treatment and the difference between control (non-primed seeds) and primed seeds in Table-2 was entirely relevant.

Analysis of variance

The variance analysis presented in Table 1 for growth, seed yield, and yielding attributes. Analysis of variance showed that the variations between 13 treatments were important for characters that attribute growth and yield, viz. Percentage of field emergence, days to 50% flowering, days to maturity, plant height, number of clusters per plant, number of pods per plant, pod weight per plant, yield of seeds per plant, yield of seeds per plot, biological yield and index of harvest.

Mean performance

Mean value is defined by the ratio of the sum of the observations to the total number of observations. On other hand, the range is the simplest measurement in mathematical calculation and simple to understand. It avoids variation of overall data and depends only on extreme values. The data presented in Table 2 shows the mean performance of 13 treatments for 11 growths, yield, and yielding attributes. The grand mean for all the traits is also depicted in Table 2. Pre-sowing seed treatment with maximum percentage of field emergence (88.00%)was highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (87.00%) and found to be lowest inT_0- Control (78.33%). The influence of pre-sowing seed treatment on the percentage of field emergence was found to be

an important and comparable finding observed by Fiszer *et al.,* (2004); Hirota *et al.,* (1999) and Patil *et al.,* (2012).

Maximum days taken to 50% flowering at flowering stage (34 days) was highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (36 days) and found to be lowest inT_0- Control (46 days)The impact of pre-sowing seed treatment on days with a flowering rate of 50 percent was found to be important and similar. Aleman *et al.,* (2014) and Sarmadi *et al.,* (2014).

Maximum days to taken maturity (103.33) was highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (104.67) and found to be lowest inT_0- Control (117.33). The impact of treatment with pre-sowing seeds on days to maturity was found to be significant and similar finding observed by Moreón *et al.,* (2007); Hunt *et al.,* (2009); Ali *et al.,* (2011).

Maximum Plant height at harvesting stage (103.20 cm) was highest in T_{11}- KNO_3 @ 5% followed by T_2- Magnetic treatment (MT 100) @ 35 minutes (99.63 cm) and found to be lowest in T_0- Control (71.60 cm).

The impact of treatment with pre-sowing seeds on days to maturity was found to be significant and similar finding observed by Vazirimehr *et al.,* (2014); Mariappan *et al.,* (2013); Flórez *et al.,* (2012); Galland and Pazur, (2005)

Number of clusters per plant(13.86) was highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (13.80) and found to be lowest inT_0- Control (8.53). The impact of treatment with pre-sowing seeds on days to maturity was found to be significant and similar finding observed by Ali *et al.,* (2011) and Somasundaram *et al.,*

(2008). Number of pods per plant (81.50) was highest in T_{11}- KNO$_3$ @ 5% followed byT_6- Panchgavya @ 3% (79.70) and found to be lowest in T_0- Control (56.13). The impact of treatment with pre-sowing seeds on days to maturity was found to be significant and similar finding observed by Mehri (2015); Podleoeny *et al.,* (2004).

Pods weight per plant (41.10 g) was highest in T_{11}- KNO$_3$ @ 5% followed by T_2- Magnetic treatment (MT 100) @ 35 minutes (40.30 g) and found to be lowest in T_0- Control (28.83 g). It was found that the effect of pre-sowing seed treatment on the number of seeds per pod was important and similar to the findings observed by Sarmadi *et al.,*(2014);Shine M.B. (2011); Pietruszewski S. (2002).

Maximum seed yield per plant and seed yield per plot (10.12g and 446.10g) respectively were highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (9.61 g and 412.60 g) respectively and found to be lowest in T_0- Control(5.80g and 181.40 g) respectively. It was found that the effect of pre-sowing seed treatment on the number of seeds per pod was important and similar to the findings observed by Johnson *et al.,* (2005); Pietruszewski and Wójcik (2000); Simi *et al.,* (2013).

Biological yield (1505.97 g) was observed highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (1463.62 g) and found to be lowest in T_0- Control (793.85 g). It was found that the effect of pre-sowing seed treatment on the number of seeds per pod was important and similar to the findings observed by Schwinn, F. (2014); Iqbal *et al.,* (2012); Martinez *et al.,* (2000); Dalal *et al.,* (2014).

Harvest index(29.61%) was observed highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (28.17%)

and found to be lowest in T_0- Control(22.84%). It was found that the effect of pre-sowing seed treatment on the number of seeds per pod was important and similar to the findings observed by Farooq *et al.,* (2012); Vashisth and Nagarajan (2008); Shashurin *et al.,* (2014).

Summary

Significant differences in all the field observations were observed due to the environmental effect on the different treatment of cluster bean bean. The significantly maximum percentage of field emergence (88.00%)was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (87.00%) and found to be lowest inT_0- Control (78.33%). Plant height at harvesting stage (103.20 cm) was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes(99.63 cm) and found to be lowest in T_0- Control (71.60 cm).Days to 50% flowering at flowering stage (34 days) was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (36 days) and found to be lowest inT_0- Control (46 days) Number of clusters per plant(13.86) was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (13.80) and found to be lowest inT_0- Control (8.53).

Number of pods per plant (81.50) was highest in T_{11}- KNO$_3$ @ 5% followed byT_6- Panchgavya @ 3% (79.70) and found to be lowest in T_0- Control (56.13). Days to maturity (103.33) was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (104.67) and found to be lowest inT_0- Control (117.33).Pods weight per plant (41.10 g) was highest in T_{11}- KNO$_3$ @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes(40.30 g) and found to be lowest in T_0- Control (28.83 g).

Table.1 Analysis of variance for 11 characters of growth and yield in cluster bean

S.No.	Characters	Mean sum of square		
		Replications (df=2)	Treatments (df=12)	Error (df=24)
1.	Field Emergence Percentage	3.18	29.81[*]	4.10
2.	Plant height (cm)	15.91	276.52[*]	8.41
3.	Days to 50% flowering	1.33	34.32[*]	5.19
4.	Number of clusters per plant	2.22	10.66[*]	0.77
5.	Number of pods per plant	34.33	276.42[*]	10.71
6.	Days to maturity	22.26	61.45[*]	10.81
7.	Pods weight per plant	28.48	47.61[*]	8.74
8.	Seed yield per plant (g)	0.27	5.72[*]	0.32
9.	Seed yield per plot (g)	18846.81	21945.68[*]	1018.15
10.	Biological yield (g)	260957.17	168987.73[*]	13515.69
11.	**Harvest index**	**7.59**	**13.36**[*]	1.07

Table.2 Mean performance of cluster bean for growth, yield and yield attributing characters of Clusterbean

Treatments	Field Emergence Percentage	Plant Height (cm)	Days to 50% Flowering	Number of Clusters per Plant	Number of Pods per Plant	Days to Maturity	Pods weight per plant	Seed yield per plant (g)	Seed yield per plot (g)	Biological Yield (g)	Harvest index (%)
T_0	78.33	71.60	45.33	8.53	56.13	117.33	28.83	5.80	181.40	27.84	20.83
T_1	80.00	72.07	43.33	9.73	58.50	115.55	30.73	6.39	190.77	29.34	21.74
T_2	87.00	99.63	35.67	13.80	79.20	104.67	40.30	9.61	412.60	33.63	28.57
T_3	83.67	87.00	39.67	10.20	60.80	111.33	35.27	7.88	297.03	30.73	25.63
T_4	81.33	81.90	41.33	11.20	56.00	113.67	33.20	7.10	256.53	29.82	23.80
T_5	79.00	76.20	44.67	9.00	54.23	116.33	31.67	6.02	210.47	26.48	22.73
T_6	86.33	92.17	37.33	13.13	79.70	106.67	39.13	9.21	388.93	32.23	28.57
T_7	84.00	88.60	39.33	11.33	68.20	109.67	36.57	8.09	304.70	30.74	26.31
T_8	82.67	85.10	40.67	10.80	65.13	112.33	35.03	7.44	286.60	29.76	25.00
T_9	85.00	88.73	38.78	13.20	71.37	108.31	38.70	8.51	324.57	31.48	27.03
T_{10}	80.67	81.03	42.33	13.80	70.10	114.67	32.07	6.88	233.40	29.58	23.25
T_{11}	88.00	103.20	34.33	13.86	81.50	103.33	41.10	10.12	446.10	34.40	29.41
T_{12}	85.67	91.60	37.78	12.26	73.30	107.55	39.00	8.83	368.53	31.78	27.78
Grand Mean	83.21	86.06	39.94	11.61	67.24	110.87	35.51	7.84	300.13	30.60	25.43
C.D.(5%)	4.73	4.11	3.84	1.47	5.52	5.54	4.98	0.74	12.20	2.77	2.79
SE(m)	1.62	1.41	1.32	0.50	1.89	1.90	1.71	0.25	4.18	0.95	0.96
SE(d)	2.29	1.99	1.86	0.71	2.67	2.68	2.41	0.36	5.91	1.34	1.36
C.V.	3.37	2.83	5.71	7.54	4.87	2.98	8.33	5.63	2.41	5.36	6.46

Significantly maximum seed yield per plant and seed yield per plot (10.12g and 446.10g) respectively were highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (9.61 g and 412.60 g) respectively and found to be lowest in T_0- Control (5.80g and 181.40 g) respectively. Biological yield (1505.97 g) was observed highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (1463.62 g) and found to be lowest in T_0- Control (793.85 g). Harvest index(29.61%) was observed highest in T_{11}- KNO_3 @ 5% followed byT_2- Magnetic treatment (MT 100) @ 35 minutes (28.17%) and found to be lowest in T_0- Control (22.84%).

Subsequent conclusions are drawn based on observations derived from the current experiment. The treatment of pre-sowing seeds increases the germinability and vigour of Cluster bean seeds, substantially in field conditions. Pre-sowing seed treatment with Potassium nitrate (5% for 8 hours) followed by Magnetic treatment @ 100 MT (35 min), Electric treatment @ 20mA (5 min), Potassium nitrate (7% for 8 hours) and Agniastra (5% for 8 hours) significantly increase the Field emergence percentage, Plant height, Number of clusters per plant, Number of pods per plant, Pods weight per plant, Seed yield per plant and Seed yield per plot parameters of cluster bean (Pusanavbahar).

Pre-sowing seed treatment with KNO_3 (5% for 8 hours) and Magnetic treatment @ 100mT (35 min) showed maximum increase in germinability and vigour of cluster bean seeds and found to be lowest in control seeds. Pre-sowing seed treatment of the cluster bean seeds in which KNO_3 best result to enhance germinability, vigour and quality parameters. These conclusions are based on the results of six months investigation and therefore further investigation is needed to arrive at valid recommendations.

Acknowledgement

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