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Effects of seed priming methods on growth and Nodulation characters in Pigeonpea (*Cajanus cajan* L.) seeds

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Abstract

The experiment was conducted in field experiment centre; Department of Genetic and Plant Breeding SHUATS Allahabad UP during kharif season 2016, in order standardize the best method of priming specific to pigeonpea Bahar variety. Seed priming using various method like that viz., hydropriming, helopriming and osmopriming, biopriming were evaluated by screening a range of duration and concentration viz., T₀ Control, hydropriming, osmopriming- PEG (20%), helopriming (KCl 1%), (CaCl₂ 1%), biopriming (Neem leaf Extract 5%) and (Eucalyptus extract 5%) for 14 hours. It was found that all the priming treatments showed significance difference with the control and the highest field emergence percent and plant nodulation characters were observed for PEG₆₀₀₀ priming highest nodulation was observed in PEG and KCl. Seed priming, its simplicity and no requirement for expensive equipment and chemical could be used as a simple method for overcoming related to a poor germination and seedling establishment and helps in sustaining agriculture and cost effective and economic, non-toxic, eco-friendly sources.

Keywords: Pigeonpea, method of priming, duration, Nodulation, PEG₆₀₀₀, Kcl, eucalyptus leaf extract

Introduction

Pigeonpea is a protein rich staple food. It contains about 22 percent protein, which is almost three times that of cereals. Pigeonpea supplies a major share of protein requirement of vegetarian population of the country. The combinations of Dal-Chawal (pulse-rice) or Dal-Roti (pulse-wheat bread) are the main ingredients in the average Indian diet. In addition to being an important source of human food and animal feed, Pigeonpea also plays an important role in sustaining soil fertility by improving physical properties of soil and fixing atmospheric nitrogen. Being a drought resistant crop, it is suitable for dryland farming and predominantly used as an intercrop with other crops. Pigeonpea [*Cajanus cajan* (L.) Millsp.] belongs to family Leguminosae. Numerous nodules are present on roots, these nodules contain Rhizobium bacteria, which fixes atmospheric nitrogen. The flowers are self-pollinated but cross-fertilization may also occur to some extent. The fruit of the Pigeonpea is a pod. Seeds are round or lens shaped. Numerous species of *Cajanus* are known, differing in height, habit, time of maturity, colour, size and shape of pods and seeds. Some Bacillus sp prompted nodulation and SNF of pea (*Pisum sativum*) by phosphate solubilisation (Mishra *et al.*, 2009a)^[7] and IAA production (Mishra *et al.*, 2009b)^[8] and enhanced nodulation of pigeonpea (*Cajanus cajan*) by the production and secretion of siderophores (Rajendran *et al.*, 2008)^[10]. Halo priming refers to soaking of seeds in solution of inorganic salts i.e. NaCl, KNO₃, CaCl₂, CaSO₄, etc. Osmopriming or osmoconditioning include alternate wetting and drying, pre germination and controlled hydration by means of an osmoticum such as poly ethylene glycol PEG. Fifty three farmers tested maize seeds priming in the kharif season in 1996 in tribal areas of Rajasthan, Gujarat and Madhya Pradesh; India (Harris *et al.*, 1999)^[2]. Almost all farmers thought that primed crops grew more vigorously, flowered and matured earlier and produced bigger cobs and higher yield. Independent measurements on a subset of 35 trials showed a mean increase in cob weight of 6% (Harris *et al.*, 2001)^[3]. Nodulation starts approximately 15 days after sowing (DAS) and continues up to 120 days. It declines towards pod filling (Kumar Rao 1990)^[5]. The nodule development is through the meristematic zone, arching around the apical end and the medulla contains many bacteroid-filled cells. Sometimes the latter are highly vacuolated (Bisen and Sheldrake 1981)^[11]. The nodules differ in size from 2-4 mm. They may be spherical, oval, elongate, or branched.

Materials and methods.

The present investigation was carried using genetically pure seeds of Pigeonpea cultivar Bahar and the Experiment was conducted in the Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad. After cleaning and grading, the seeds were soaked in respective priming solutions at 1/3rd volume of seeds for eight and twelve hours. Then the seeds were air dried under the shade to bring back to their original moisture content and used for sowing. For priming of seeds kcl, CaCl₂, Neem leaf Extract, Eucalyptus Leaf Extract are taken according to standards.

The data collected from the experiments were analyzed statistically by the procedure prescribed by Panse and Sukhatme (1978). The investigations are details of materials and using of experimental design in complete randomized block methods. Critical difference were calculated at 1% level wherever 'F' test was significant. The data on percentage of germination and seed infection were transferred into arc sine square root percentage values and the transferred data were used for statistical analysis. Absolute control treatment was compared with rest of the treatment by following ANOVA statistical analysis.

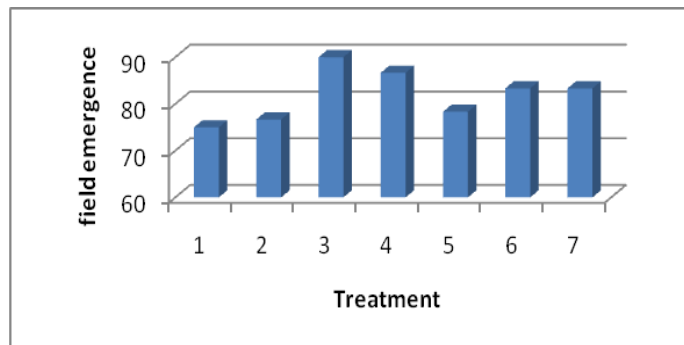
$$\text{Field emergence (\%)} = \frac{\text{Number of seedling emerged on 15}^{\text{th}} \text{ days}}{\text{Total no. of seeds sown}} \times 100$$

One hundred seeds from each treatment in three replications were used for field emergence studies. The seeds were sown in well prepared at 3m deep. The field emergence count was taken on the 15th day after sowing and the emergence percentage was calculated taking into account the number of seedlings emerged three centimeter above the soil surface.

RESULT AND DISCUSSION

1. Field emergence percentage

The mean performance of field emergence percentage ranged from 75.33 to 90.00 with mean value of 79.43. Maximum field emergence percentage (90.00) was recorded by T₂ with application of Polyethylene glycol (PEG) 20% and it was followed by T₄ (81.67) with application of Calcium chloride (CaCl₂) 1% and T₆ (81.00) with application of Eucalyptus leaf extract 5%. Minimum germination percentage was recorded by T₀ (75.33) with Control.

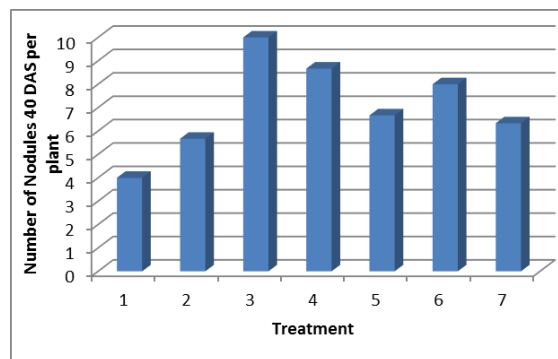


2. Number of nodules per plant

a) Number of nodules per plant DAS 40 days.

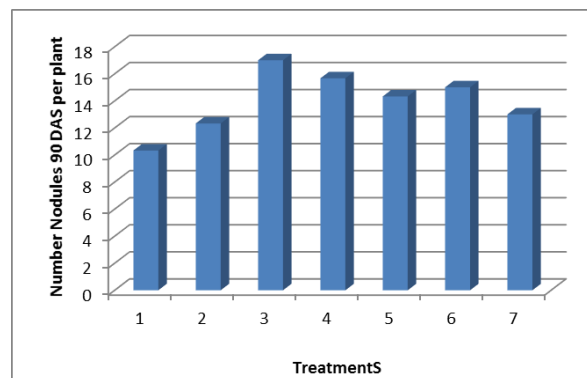
The mean performance of number of nodules per plant at 40 days after sowing ranged from 4.00 to 10.00 with mean value of 7.05. Maximum number of nodules (10.00) was recorded by T₂ with application of Polyethylene glycol (PEG) 20% and

it was followed by T₃ (8.67 cm) with neem leaf extract T₅ (5%) (8.00) and application of Calcium chloride (CaCl₂) 1% and T₄ (6.67) with application of eucalyptus leaf extract 5% T₆ (6.33). Minimum number of nodules was recorded by T₀ (4.00) with control.



b). Number of nodules per plant at 90 DAS

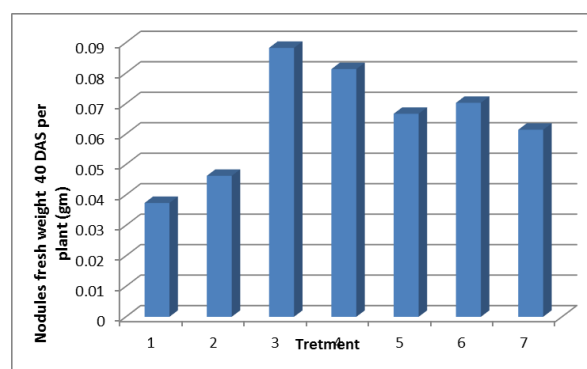
The mean performance of number of nodules at 90 days after sowing ranged from 10.33 to 17.00 with mean value of 14. Maximum number of nodules (17.00) was recorded by T₂ with application of Polyethylene glycol (PEG) 20% and it was followed by T₃ (15.67) with neem leaf extract T₄ (14.33) and application of Calcium chloride (CaCl₂) 1% T₄ (14.33) with control.



3. Nodules fresh weight

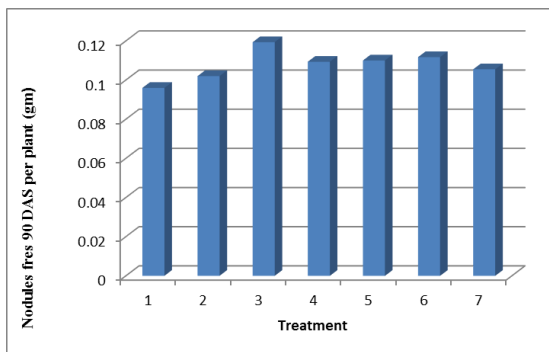
a) Nodules fresh weight at 40 DAS.

The mean performance of nodules fresh weight (gm) 40 days after sowing ranged from 0.03737 to 0.08827 with mean value of 0.06450. Maximum nodules fresh weight (0.08827 gm) was recorded by T₂ with application of Polyethylene glycol (PEG) 20% and it was followed by T₃ (0.08130 gm) with (KCl) (1%) and neem leaf extract T₅ (5%) (0.07023 gm), with application of Calcium chloride (CaCl₂) 1% and T₄ (0.06663 gm) with hydration (0.04627 gm) Minimum nodules fresh weight was recorded by T₀ (0.03737 gm) with control.



b) Nodules fresh weight at 90 DAS

The mean performance of nodules fresh weight(mg) 90 days after sowing ranged from 0.096 to 0.011933 with mean value of 0.010778. Maximum nodules fresh weight (0.011933 gm) was recorded by T₂with application of Polyethylene glycol (PEG) 20% and it was followed by T₃ (0.010933gm) with Neem leaf extract T₅ (5%) (0.011170gm) with application of Calcium chloride (CaCl₂) 1% and T₄(0.011000gm) and eucalyptus leaf extract (5%) T₆(0.01050gm) with hydration T₁ (0.0102gm) Minimum nodules fresh weight was recorded by T₀ (0.096 gm) with control.



3. Nodules dry weight

a) Nodules dry weight at 40 DAS

The mean performance of nodules dry weight (gm) 40 days after sowing ranged from 0.01617 to 0.03460 with mean value of 0.02647. Maximum nodules dry weight (0.03460 mg) was recorded by T₂ with application of Polyethylene glycol (PEG) 20%and it was followed by T₃ (0.03233gm) with application of (KCl) 1% and T₅ (0.02823gm) with application of Neem leaf extract 5%.with T₄ (0.02783gm)

Calcium Chloride (CaCl₂) 1% with T₆ (0.02313gm) Eucalyptus leaf extract (5%) and T₁ (0.023gm) Minimum nodules dry weight was recorded by T₀ (0.01617 gm) with control.

b) Nodules dry weight at 90 DAS

The mean performance of nodules dry weight (mg) 90 days after sowing ranged from 0.04107 to 0.05533 with mean value of 0.04796 Maximum nodules dry weight (0.0553 gm) was recorded by T₂with application of Polyethylene glycol (PEG) 20%and it was followed by T₃ (0.053gm) with application of (KCl) 1% and T₅(0.050gm) with application of Neem leaf extract 5%.with T₄ (0.0473gm) Calcium Chloride (CaCl₂) 1% with T₆ (0.045gm) Eucalyptus leaf extract (5%) and T₁ (0.044gm) Minimum nodules dry weight was recorded by T₀ (0.04107 gm) with control.

Effect of different treatments on Nodules dry weight 90 DAS.

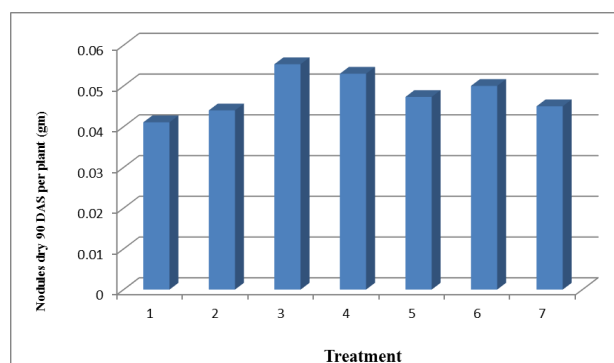


Table 1.1: Analysis of variance for different field emergence and nodulation traits in Pigeonpea

| Characters | Mean Sum of Square (MSS) | |
|--|--------------------------|-----------------|
| | Treatment (df = 6) | Error (df = 12) |
| Field emergence percentage | 90.08 | 88.89 |
| No.of nodulation per plant 40 days | 12.05 | 1.69 |
| No.of nodulation per plant 90 days | 14.78 | 2.18 |
| Fresh weight of no of nodulation per plant 40 days | 0.98140 | 0.11732 |
| Fresh weight of no of nodulation per plant 90 days | 0.16394 | 0.05136 |
| Dry weight of nodulation per plant 40 days | 0.17739 | 0.02719 |
| Dry weight of no of nodulation per plant 90 days | 0.07814 | 0.01190 |

Table 2.2: Mean Comparison of field emergence and nodulation traits in pigeonpea.

| Treatment | Field emergence % | No. of nodulation per plant in 40 days | No. of nodulation per plant in 90 days | Fresh weight of nodulation per plant in 40 days (gm) | Fresh weight of nodulation per plant in 90 days(gm) | Dry weight of nodulation per plant in 40 days (gm) | Dry weight of nodulation per plant in 90 days (gm) |
|-----------|-------------------|--|--|--|---|--|--|
| T0 | 75 | 4 | 10.33 | 0.03737 | 0.096 | 0.01617 | 0.04107 |
| T1 | 76.67 | 5.67 | 12.33 | 0.04627 | 0.102 | 0.023 | 0.044 |
| T2 | 90 | 10.00 | 17.00 | 0.08827 | 0.11933 | 0.03460 | 0.05533 |
| T3 | 86.67 | 8.67 | 15.67 | 0.08130 | 0.10933 | 0.03233 | 0.053 |
| T4 | 78.33 | 6.67 | 14.33 | 0.06663 | 0.110 | 0.2783 | 0.0473 |
| T5 | 83.33 | 8 | 15.00 | 0.07023 | 0.11170 | 0.02823 | 0.050 |
| T6 | 83.33 | 6.33 | 13.33 | 0.06140 | 0.1055 | 0.02313 | 0.045 |
| G mean | 81.90 | 7.05 | 14 | 0.06450 | 0.10778 | 0.02647 | 0.04796 |
| CD (5%) | 16.77 | 2.31 | 2.63 | 0.01927 | 0.01275 | 0.0928 | 0.0614 |
| F test | NS | S | S | S | S | S | S |

Summary

The effect of priming method found to be significant in all the nodule parameters. In all the nodule parameters the effect of priming method was found significant highest in PEG₆₀₀₀in field emergence (90.00) followed by KCl (86.67) compare to

unprimed seeds control (75). Number of nodules per plant (4 and 10) were highest in osmo primed (PEG₆₀₀₀) seeds and lowest in unprimed (control) seeds. (10.33 and 17.00) 40 and 90 DAS respectively. Nodule fresh weight was highest observed in post having seed primed with PEG₆₀₀₀

(osmoprimered) (0.8827 and 0.11933 gm) and lowest in unprimed (control) seeds (0.3737gm and 0.096gm) 40 and 90 DAS respectively. Nodules dry weight was observed to be higher in PEG₆₀₀₀ primed seeds (0.03460 gm and 0.05533 gm) and found to be lowest in unprimed (control) seeds (0.01617gm and 0.04107gm) 40 and 90 DAS respectively.

Conclusion

It is concluded from the present investigation that treatment T₂ [Polyethylene Glycol (PEG) 20%] exhibited high mean value for germination, seedling parameters, field emergence and nodules characters in compared with other treatments. Soaking of seed with PEG solution is advantageous to obtain healthy seedlings. The second best option for priming is halo priming with KCl.

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