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RESEARCH ARTICLE

EFFECT OF DIFFERENT CHEMICAL PRIMING METHODS ON GERMINATION AND SEEDLING PARAMETERS OF BLACKGRAM SEEDS

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ABSTRACT

This study was done to determine the effect of different seed priming methods on germination and seedling parameters of black gram. The experiment was laid out in Completely Randomized Design replicated thrice. Treatment combinations were; control (no priming), hydro priming, Osmo priming (PEG-10% and 20%), halo-priming (1% NaCl and 1% KNO3), and hormonal priming (Salicyclic acid 125ppm). For all treatments, seeds were soaked for 12 hours and dried in ambient conditions, and grown for 8 days at 24°C in a germinator, and readings were taken. PEG (10%) exhibit the highest GP (96.8) followed by hydro priming (94.4). 1 % NaCl showed the highest value of GE and GI. The highest value of MGT was shown by PEG (10%). Whereas the highest value of CVG was given by Salicylic acid 125 ppm. The seedling parameters like root length (10.251), shoot length (10.671), and dry weight (4.580) was maximum in seeds primed with Salicyclic acid except for the SVI which was highest in PEG 10% primed seeds (1846.708). The lowest value of seed GP and SVI was shown by non-primed seeds. It was found that primed seeds were superior over non primed ones regarding parameters studied.

KEYWORDS

Blackgram, Salicyclic Acid, Germination, PEG, Priming, Seedling growth.

1. INTRODUCTION

The leguminous crop, black gram (Vignamungo L. Hepper) is a highlyproteinous warm-season crop, mainly used as Dal and in other dishes. It is generally planted in a cereal-pulse cropping system during the rainy season. It enhances soil fertility by nitrogen fixation. In the context of Nepal, it is less prioritized than other pulses and iscultivated mostly in marginal rainfed areas under poor agronomic practices. Thus, seeds experience moisture stress during germination and seed establishment due to untimely rainfall causing poor performance in germination and seedling parameters. Seed priming is a physiological approach that involves hydrating and drying seeds to promote metabolic processes before germination, resulting in higher germination percentages and rates, as well as improved seedling growth and crop output under normal and biotic and abiotic conditions. Before sowing seeds, they are given a seed priming treatment, which entails hydrating them sufficiently to allow metabolic events to occur before germination while avoiding radicle emergence (Nascimento et al., 2004).

It improves embryonic tissue expansion by synchronizing germination after breaking dormancy, reducing the lag time necessary for imbibition, hydrolyzing or metabolizing inhibitors, activating enzymes, mobilizing reserved food, and hydrolyzing or metabolizing inhibitors (Nascimento et al., 2004; Rafi et al., 2015). In this experiment, we performed the first 4 methods, namely; hydro (distilled water) priming, hormonal priming (salicylic acid), halo priming (KNO3 and NaCl), and osmo-priming (PEG). And the results are compared to unprimed seeds.This research was done to enhance the growth and development of this less prioritized crop which is usually grown in marginal land where there may be a lack of soil moisture during critical growth stages and recommend the best priming methods for farmers in rainfed conditions.

2. MATERIALS AND METHODS

The experiment was done in agronomy lab, lamjung campus designed in CRD with 7 treatments and five replication. The local variety of blackgram seeds was used for the experiment. Four methods of priming were done namely; hydropriming (distilled water), Osmopriming (10% and 20% of PEG), halopriming (NaCl 1% and KNO3 1), and hormonal priming (salicylic acid 125 ppm), and the observation was compared with unprimed (control) seeds. During the experiment, seeds were soaked for five minutes in 5% sodium hypochlorite for sterilization and rinsed with distilled water. Seeds were soaked in treatment solution and redried in ambient conditions for 24 hours. Dried seeds were allowed to grow on a Petri dish containing 25 seeds in each dish and grown in a germinator. Distilled water was used to provide the growing condition for seeds. Seeds with a ruptured seed coat and a radical length of more than 2mm were regarded as germinated (Mackay et al., 1995). The daily observation was taken for eight days and data was analyzed using Ms excel and R studio.

3. RESULTS

3.1 Seed Germination

As indicated in Table 2, seed priming had a significant impact on germination % compared to unprimed seeds. The percentage of seeds that germinated after hydro-primed or PEG 10% was statistically similar and higher compared to others. Similar results were obtained in lentils (Aliloo et al., 2008). When PEG concentration was increased to 20%, a decrease in the total germination percentage had been reported.

3.2 Root and Shoot Length, R:S Ratio Dry Weight and Vigor

Priming caused a significant impact on the root length. Hormonal priming (Salicylic acid) showed the highest root length compared to other priming methods, followed by Osmotic priming (PEG). The effect of salicylic acid in root length is similar to done in garden cress in saline stress conditions (Javanmard et al., 2013). An increase in PEG slightly reduced the root length as given in Table 2. Seeds primed with salicylic seeds were most taller, similar to in sesame (Ahmad et al., 2019). Hydro-primed seeds did poor performance than the control in shoot length. Overall primed seeds had a greater root-shoot ratio than un-primed seeds. Osmo priming (PEG) performed best compared to other treatments followed by salicylic acid.Salicylic acid showed the highest dry weight in the wheat seedling (Jiriaie et al., 2013). followed by PEG 10%. The dry weight decreased with

the increase in concentration. Maximum seed vigor index I was obtained on seeds primed with PEG 10% but decreased when the concentration was increased. A similar effect of PEG concentration was observed in (Varshini et al., 2018).

Table 1: List of Parameters Studied in The Experiment.

Germination Parameter	Unit	Formula	Description	Reference
Germination Percentage (GP)	%	GP= (n/N) ×100%	N = no of germinated seeds N= total no of seeds used	The greater the GP value, the greater the seed population germination (Scott et al., 1984).
Mean Germination Time (MGT)	day	MGT= ∑f.x /∑ f	F = seeds germinated on day x	The faster a population of seeds germinatation, the lower the MGT (Orchard, 1977).
Coefficient of Velocity of Germination (CVG)	day	CVG= N1 + N2 + •••+Nx/100 × N1T1+•••+NxTx	N = No. of seeds Germinated each day, T= No. of days from seeding corresponding to N	The CVG shows how quickly seeds germinate. It rises when the quantity of seeds that germinate increases and the germination period lengthens. The maximum CVG that might exist theoretically is 100. If all seeds germinated on the first day, this would occur (Jones and Sanders, 1987).
Germination index (GI)	-	GI= (8×n1) (7×n2) +•• • • + (1×n8)	n1, n2 . . . n8 = no of germinated seeds on corresponding days; 8,7...1 are weights given to the number of germinated seeds on the first, second and subsequent days, respectively	The seeds that germinate on the first day are given the maximum weight in the GI, while seeds that germinate later are given less weight. The seeds that germinated on the last day of observation would have the minimum weight. The GI therefore emphasizes both the rate of germination and its percentage. A higher GI rating indicates a higher germination rate and percentage (Benech Arnold et al., 1991).
Seedling Vigor Index-1(SVI-1)	-	SVI-1=SL×GP	SL=seedling length(cm) GP=germination percentage -	(Abdul-Baki and Anderson, 1973)

Table 2: Effect of Different Priming Methods on Germination Percentage, Root Length, Shoot Length, Root-Shoot Ratio, Dry Weight, and Seedling Vigor Index-1.

Treatment	Germination Percentage	Root Length	Shoot Length	Root -Shoot Ratio	Dry Weight	Vigor Index-1
Hydro-priming	94.4a	6.860cd	8.520b	0.8522ab	2.874bc	1453.128b
PEG (10%)	96.8a	9.429ab	9.598ab	1.0040a	3.674ab	1846.708a
PEG (20%)	84.0b	9.06ab	8.562b	1.0622a	2.978bc	1483.808b
NaCl (1%)	92.8ab	8.228bc	8.886ab	0.9316a	2.338c	1588.320ab
KNO_3 (1%)	92.0ab	8.126bc	10.290ab	0.8112ab	2.980bc	1691.576ab
Salicylic acid (125 ppm)	84.0b	10.251a	10.671a	0.9642a	4.580a	1757.664ab
Control	73.6c	5.251d	9.234ab	0.6212b	2.790bc	1092.544c
Grand Mean	88.22857		9.394429	0.8923714	3.173429	1559.107
LSD	9.157579	0.06268929	1.756334	0.252714	1.041679	306.9113
CV%	8.066413	12.42948	16.49203	21.85936	25.33722	15.19465

3.3 Speed of Germination

As indicated in table 3, the germination index, germination index, coefficient of the velocity of germination, and mean germination time were used to evaluate germination speed. Priming methods had a significant effect on the speed of germination.PEG 10% worked well in germination energy and germination index but had the highest MGT. Salicyclic acid had the lowest MGT (2.254) and highest CVG representing the fastest germination. A similar effect on MGT was observed by in sesame seeds (Ahmad et al., 2019). Seeds primed with PEG 10% took the longest time to germinate. Overall, salicylic acid primed seeds had the highest speed of germination.

Table 3: Effect of Different Priming Methods on The Speed of Germination.

Treatment	Germination Energy (GE)	Germination Index GI)	Coefficient of Velocity of Germination (CVG)	Mean Germination Time (MGT)
Hydro-priming	0.608c	121.2ab	0.3547051c	2.854095ab
PEG (10%)	0.808ab	121.4ab	0.3421875c	2.978435a
PEG (20%)	0.760ab	117.0b	0.4190885ab	2.421579bcd
NaCl (1%)	0.832a	131.4a	0.4316931a	2.421579cd
KNO_3 (1%)	0.744b	120.6ab	0.3687247bc	2.752870abc
Salicylic acid (125 ppm)	0.728b	120.6ab	0.4468489a	2.253747d
Control	0.472d	96.0c	0.3619126bc	2.799396ab
Grand Mean	0.7074286	118.3143	0.3893086	2.627844
LSD	0.09654932	12.26515	0.06268929	0.4377653
CV	10.53466	8.001834	12.42948	12.85865

4. Discussion

Germination and early seedling parameters had been obtained to be influenced by different priming methods. Increased metabolic activity may be responsible for earlier and more synchronized germination in hydro-primed seeds and osmo-primed seeds increasing the germination % of seeds (Kang et al., 2000; Mirmazloum et al., 2020). Cell division and enlargement are increased by hormonal priming which consequently enhances the seedling growth increasing shoot length in seeds primed with salicylic acid (Feucht and Watson, 1958). Although SalicyclicAcid is not essential for germination under normal growth conditions, it has been shown to have a promotive role in seed germination under high salinity by reducing oxidative damage subjected to increased seedling parameters (Lee et al., 2010). Increased R:S ratio in halo-primed seeds had been linked to the increased nuclear replication in the root tips of fresh seeds induced by halopriming (Stoffella et al., 1992).

5. Conclusion

All chemical priming treatments boosted germination and seedling development when compared to unprimed seeds, suggesting that chemical priming is the better technique for improving germination in blackgram. PEG 10% primed seeds had the highest germination percentage statistically at par with hydro-primed seeds. Overall, salicylic acid-primed seeds produced the best seedling development along with other seedling parameters. Farmers can use hormonal priming treatments like salicylic acid to enhance crop development and productivity for better results.

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