GERMINATION AND SEEDLING VIGOUR OF SOYBEAN (*Glycine max*) AND BLACKGRAM (*Vigna mungo*) AS AFFECED BY PRIMING METHODS IN LAMJUNG

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ABSTRACT

To address poor germination and seedling establishment in legume cultivation this study explored the impact of seed priming with different concentrations of gibberellic acid (GA_3) compared to hydropriming on soybean and blackgram. Two separate experiments were conducted with four replications each in Completely Randomized Design. The seeds underwent hormonal priming with varying concentrations of GA_3 - 50 ppm, 75 ppm, 100 ppm and 125 ppm and hydro-priming at the Agronomy laboratory of Lamjung Campus. For soybean, 100 ppm GA_3 produced the best results ($P<0.05$) in terms of germination rate (99%), root and seedling length, and seedling vigor index (2054.20). Meanwhile, 50 ppm GA_3 showed the fastest germination and better germination index (237.00) compared to other treatments ($P<0.05$). In blackgram, 50 ppm GA_3 treatment resulted in 100% germination and significant effects on various parameters, including coefficient of velocity of germination and germination index (244.75) while 75 ppm GA_3 exhibited the fastest germination time and longest length of root (10.85 cm) ($P<0.05$). Hydropriming improved overall seedling characteristics like seedling length and seedling vigor index (2074.16) ($P<0.05$). This highlights the effectiveness of hydro-priming, priming with 50 ppm GA_3 for blackgram and 100 ppm GA_3 for soybean, emphasizing the importance of priming methods.

Keywords: Blackgram, Gibberellic acid, Hormonal priming, Hydropriming, Soybean

INTRODUCTION

Soybean and blackgram rank second and third most important legumes after lentil in terms of area and production in Nepal (MoALD, 2081). Majorly, in Nepal, they are grown in cereal-pulse cropping method in rainy season (Timilsina and Shrestha, 2024) for their high protein content and palatability as pulse crop. Despite being importance the productivity is very low for various reasons like poor crop management (Aryal et al., 2022) and poor germination (Timilsina and Shrestha 2024) under marginal and rainfed conditions (Aryal, Shrestha and Subedi, 2020).

Poor germination leads to poor plant population and crop stand leading to lower yield. And its major problem to enhance germination in marginal soil. Thus, priming can be the utmost solution required. Hormonal priming with gibberellic acid (GA_3), offer promising solutions to enhance germination, seedling growth, stem elongation, bud growth, sexual expression, and flower and seed development (Mohammed, 2023). However, there is a lack of comprehensive research on the efficacy of hormonal priming specifically for blackgram and soybean seeds to enhance germination efficiency of local cultivars.

Therefore, this study aims to investigate the effects of hormonal priming on the germination parameters of blackgram and soybean seeds, providing insights into the most effective priming techniques for improving crop establishment and yield. By addressing the problem of low germination rates, this research contributes to the advancement of agricultural practices, fostering increased crop productivity and economic sustainability in regions reliant on these vital legume crops under marginal conditions.

MATERIALS AND METHODS

The experiment was carried in the Agronomy Lab of the Institute of Agriculture and Animal Science, Sundarbazar, Lamjung in June, 2023. Seeds of local variety of soybean (Sano pahelo) and blackgram (Kalo fusro) were obtained from the community seed bank located at Purkot, Lamjung. For the experiment, seeds with a robust, healthy, and consistent size were selected. Stock solution was prepared to further prepare working solution of (50 ppm GA_3, 75 ppm GA_3, 100 ppm GA_3 , 125 ppm GA_3 with accurate precision for each treatments. Distilled water was used for hydopriming. Two different sets of experiments in Completely Randomized Design having five treatments and four replications for each soybean and blackgram seeds were made. Twentyfive seeds were taken in each replication of the treatments summing 100 seeds for each treatment.

The seeds were subjected to a priming procedure that entailed soaking them in different GA_3 concentrations for a period of 4 hours each and for hydropriming, they were immersed in distilled water for 12 hours in sterilized petri plates. Following this, the primed seeds were washed with distilled water, left in a blotting paper to naturally air dry until surface moisture was eliminated, and then additionally air dried in shaded conditions for 12 hours to regain their initial moisture levels before carrying out further procedures.

Fort eight petri-dishes, each having diameter of 12 mm were sterilized using 95% ethanol. The germination chamber itself was also subjected to surface sterilization using 95% ethanol. Petri-dish base was covered with moistened filter papers and labelled. 25 seeds were arranged in two circles: 16 seeds at outer circle and 8 at inner circle, and 1 at center. The petri dish was put in trays inside germinator. For maintaining moisture, distilled water was sprinkled with each observation as required.

Seed germination is defined as the stage when a 2mm radicle became visibly apparent. The experiment was subject to daily monitoring, with data collection taking place once every day for a duration of up to 10 days. Alongside germination, a thorough examination and recording of various growth characteristics were also carried out.

At the end of the germination test period, five sample seedlings from each petri-dish was taken randomly. The root length, shoot length and germination count were measured and recorded. Indices were calculated using Excel and analyzed by using R-Studio software (Version 2022.12.0 Build 353).

RESULTS AND DISCUSSION

Germination and Seedling growth

Table 1: Mean separation table of germination and seedling parameters of soybean for various treatments

Treatments	Germination %	Mean Germination Time	Coefficient of velocity of germination	Germination Index	Seedling Vigour index
Hydropriming	96.00^{ab}	1.58^{b}	9.12^{b}	226.00^{b}	1839.84^{ab}
GA_3 **50 ppm**	96.00^{ab}	1.13^{c}	6.47^{c}	237.00^{a}	1631.54^{b}
GA_3 **75 ppm**	93.00^{b}	1.18^{c}	6.40^{c}	228.25^{ab}	1688.24^{b}
GA_3 **100 ppm**	99.00^{a}	1.92^{a}	11.76^{a}	224.75^{b}	2054.20^{a}
GA_3 **125 ppm**	94.00^{b}	1.23^{c}	6.83^{c}	229.50^{ab}	1596.46^{b}
F- test	***	***	***	***	***

LSD	3.01	0.27	1.58	10.33	309.99
SEM	0.17	0.02	0.09	0.57	17.14
CV%	2.51	15.38	15.51	3.59	14.01
Grand Mean	79.68	1.17	6.76	190.92	1468.38

Same letter represent statistically at par, *, **, *** represent significant difference at P value at 0.05, 0.01 and 0.001 respectively

Table 2: Mean separation table of germination and seedling parameters of blackgram for various treatments

Treatments	Germination %	Mean Germination Time	Coefficient of velocity of germination	Germination Index	Seedling Vigour index
Hydropriming	97.00^{a}	1.11^{ab}	6.56^{ab}	239.75^{a}	2074.16^{a}
GA_3 **50 ppm**	100.00^{a}	1.21^{a}	7.56^{a}	244.75^{a}	1803.00^{abc}
GA_3 **75 ppm**	96.00^{a}	1.02^{b}	5.88^{b}	239.50^{a}	1885.34^{abc}
GA_3 **100 ppm**	98.00^{a}	1.10^{ab}	6.62^{ab}	242.50^{a}	1941.56^{ab}
GA_3 **125 ppm**	96.00^{a}	1.06^{ab}	6.16^{ab}	238.50^{a}	1715.12^{bc}
F- test	***	***	***	***	***
LSD	6.03	0.17	1.44	14.77	317.52
SEM	0.33	0.01	0.08	0.82	17.56
CV%	4.93	12.47	17.46	4.88	13.42
Grand Mean	81.17	0.92	5.46	200.83	1569.86

Same letter represent statistically at par, *, **, *** represent significant difference at P value at 0.05, 0.01 and 0.001 respectively

Germination Percentage

For soybean 100% germination was observed with 50 ppm which was statistically par with hydropriming, GA_3 75 ppm, GA_3 100 ppm and GA_3 125 ppm. In case of soybean, the final germination percentage (99%) for 100 ppm GA_3 was found to be most effective compared to other treatments, similar to the findings from the research done by (Agawane & Parhe, 2015; Jassal & Singh, 2018). It was followed by Hydropriming and 50 ppm GA_3 which were statistically at par with each other. GA_3 plays a pivotal role in initiating the prompt transcription of DNA, RNA, and the synthesis of proteins in developing seeds. These enzymes subsequently facilitate the utilization of stored reserves within the endosperm, providing the necessary energy for germination and growth (Shariatmadari et al., 2017).

The improvement in germination percentage of soybean can be attributed to the role of GA_3 in stimulating the synthesis of essential enzymes required for germination and seedling vigor, as reported by (Mohammed, 2023)

Mean Germination Time

The Mean Germination Time (1.02 days) for 75 ppm GA_3 was found to be least in blackgram, and longest MGT was seen in 50 ppm GA_3 which was found to be 1.21 days.

Mean Germination Time (1.13 days) for soybean was found to be least for 50 ppm GA_3, which is statistically at par with 75 ppm GA_3 and 125 ppm GA_3. This finding was supported by the result of findings from (Thongsri et al., 2021). They summarized that soybean seeds receiving treatment with 50 ppm GA_3 exhibited a decrease in the mean germination time. The longest Mean Germination Time of 1.92 days was seen for 100 ppm GA_3.

Coefficient of Velocity of Germination

In blackgram, Coefficient of Velocity of Germination (7.56) for 50 ppm GA_3 was statistically superior to others, which is also supported by (Gangaraju et al., 2016). The least CVG was seen in 75 ppm which was 5.88.

In soybean, Coefficient of Velocity of Germination (11.76) was found to be maximum for 100 ppm GA_3, which was supported by findings from (Jassal & Singh, 2018). It was followed by Hydropriming with CVG value of 9.12%.

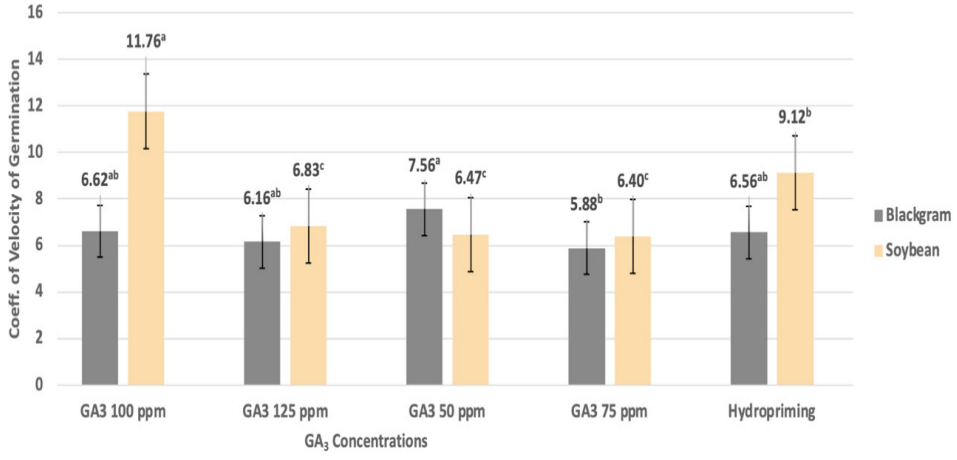

Figure 1: Effect of different GA_3 concentrations and crop type on Coefficient of Velocity of germination

Germination Index

In case of blackgram, Germination Index values were all statistically similar compared with hydropriming, showing irrelevancy of GA_3 to this parameter.

The best result for Germination Index of soybean was found in 50 ppm GA_3, similar to result from (Thongsri et al., 2021), with value of 237 seed day^{-1}, followed by 75 ppm GA_3 and 125 ppm GA_3, both statistically at par with each other. However, the lowest GI value was seen in Hydropriming and 100 ppm GA_3, which were statistically similar to each other.

Root length

In blackgram, 75 ppm GA_3 showed greater root length (10.85 cm) as compared to other treatments. It was followed by 50 ppm GA_3 and hydropriming. They were statistically similar to each other. In Soybean, 100 ppm GA_3 showed the greatest root length value of 14.75 cm, similar to results from (Agawane & Parhe, 2015), but 100 ppm GA_3 was statistically similar to all other treatments.

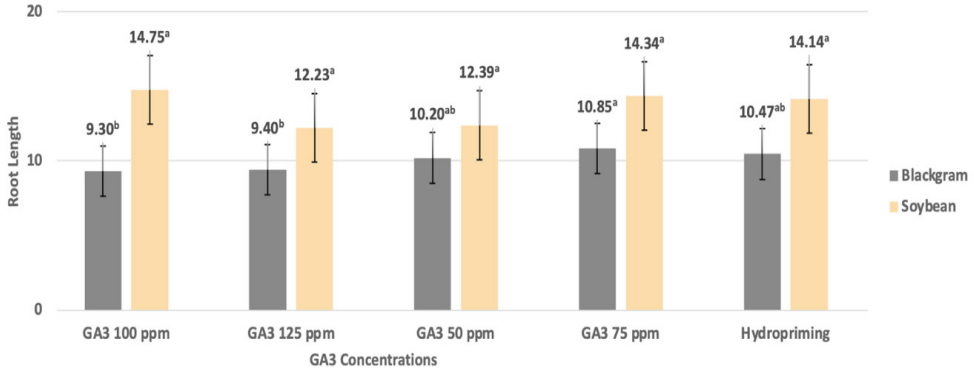

Figure 2: Effect of different GA_3 concentrations and crop type on Root Length.

Seedling length

Hydropriming of blackgram seeds gave best result in seedling length. The seedling length was 21.39 cm, which was longer compared to other treatments. It was followed by 100 ppm GA_3, which was statistically at par with 75 ppm GA_3. The seedling length for 100 ppm GA_3 was found to be longest in soybean with value 20.73 cm. It was followed by Hydropriming, which was statistically similar with 75 ppm GA_3.

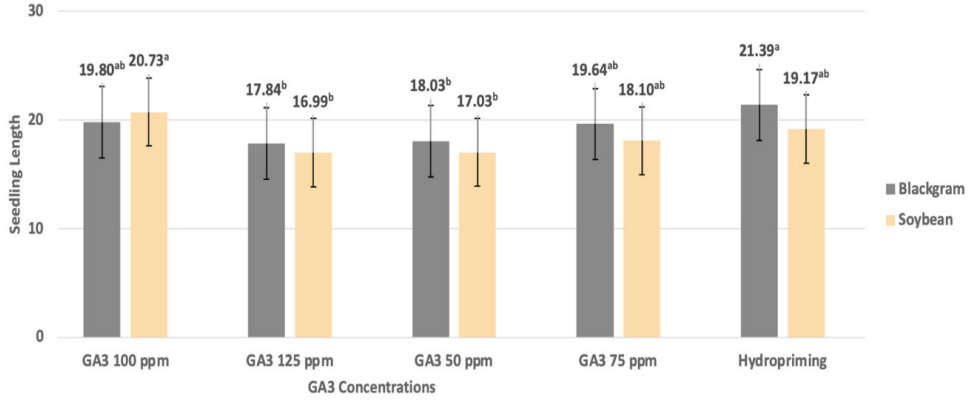

Figure 3: Effect of different GA_3 concentrations and crop type on Seedling Length

Seedling Vigor Index

In case of blackgram, highest intensity of SVI was obtained when seeds were subjected to hydropriming with SVI value of 2074.16. It was followed by 100 ppm of GA_3. The greatest Seedling Vigor Index was seen when soybean seeds were primed with 100 ppm GA_3. SVI value of 2054.20 was seen in that case. The explanation regarding the superiority of GA_3 100 ppm primed seeds are plausible for the root length and seedling vigor index as a higher positive correlation exists among them (Agawane & Parhe, 2015). It was followed by Hydropriming.

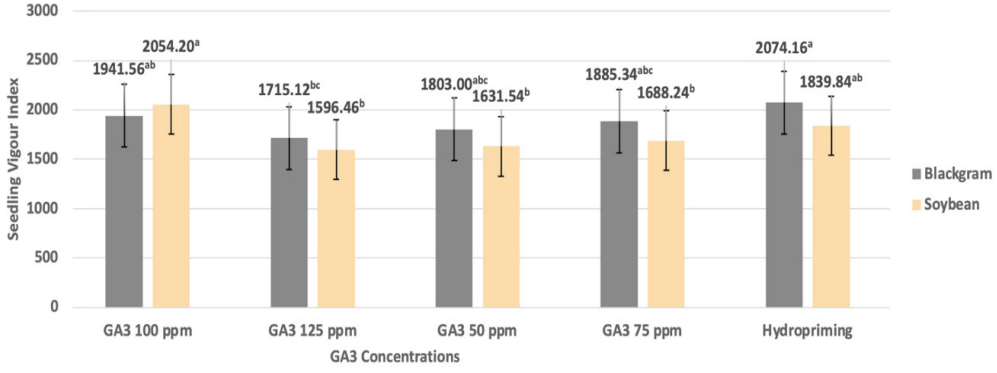

Figure 4: Effect of different GA_3 concentrations and crop type on Seedling Vigor Index.

CONCLUSION

In the experiment, there was effect of priming in different germination and seedling indices. Priming soybean seeds with 100 ppm GA_3 performed better for different germination and seedling parameters. But for blackgram, 50 ppm GA_3 gave better results for germination parameters, while hydropriming was ideal for seedling parameters. In farmers' practices, germination and subsequent seedling growth occur in the field. Priming is helpful in reducing the risk of poor seedling establishment under a wide range of environments. Therefore, it is advisable to practice hormonal priming by GA_3 100 ppm for soybean and GA_3 50 ppm and hydropriming for blackgram as a successful technique for increasing and hastening seed germination and better crop stand.

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