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Evaluation of Forage Soybean (*Glycine max* L.) Germination and Seedling Growth Enhancement by Seed Priming Techniques

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Abstract: To evaluate the comparative efficacy of different priming techniques and their effect on germination and seedling growth of soybean, a trial was executed in allelopathy laboratory of Department of Agronomy, University of Agriculture, Faisalabad, during 2009-10. The experimental design was completely randomized design (CRD) with three replications. Soybean seeds were subjected to hydro priming, on-farm priming, osmoperiming and moringa leaf extract priming. A control treatment was kept for comparison. The results revealed that all priming techniques were effective in increasing germination and seedling growth of forage soybean compared to control treatment,while moringa leaf extract priming was the most effective one in reducing time to start emergence (1.23 days) and time taken to 50% emergence (2.81 days). Root and shoot lengths were also significantly affected by all priming treatments, while priming with moringa leaf extract gave the highest root length (17.5 cm) and shoot length (19 cm). Similarly the highest root weight (0.19 g) and shoot weight (0.23 g) was also recorded by Moringa leaf extract priming. Regarding all parameters, hydropriming was statistically at par with Moringa leaf extract priming. On-farm priming performed better than osmopriming but was much less significant than Moringa leaf extract priming and hydropriming.

Key words: Seed invigoration · Hydropriming · Osmopriming · On-farm priming · Moringa leaf extract

INTRODUCTION

Soybean (*Glycine max* L.) belongs to family Fabaceae and is native to East Asia. It is being classed as oilseed rather than a pulse crop. It is also used as vegetable and forage for livestock because of its high protein contants. Poor germination in field conditions results in suboptimal plant population and ultimately foraga yield is reduced to a great extent. Germination is a process which begins with water imbibation by seeds and ends with emergence of radicle and plumule [1-4]. Poor germination of soybean (germination called epigeal in soybean as food storage structures (cotyledons) come out of the soil surface) contunues to remain a problem in achieving full potential yield. Poor germination results in lowering seedling stand and lower than optimum population causes significant reduction in yield. A variety of seed priming techniques have been worked out by researchers to increase the germination an seedling establishment of vegetable and other agricultural crops [5-8]. Seed priming entails controlled hydration of seeds to enhance the metabolic activity within the seeds [9, 10]. Among these priming techniques, hydropriming and on-farm priming have gained a wide adoption among the farming community because of their being economic and simple in use. Hydropriming involves pre-sowing seed soaking in distilled water for 6-24 hours [11], while in on-farm priming, seeds are soaked in tap water for 12-24 hours and then seeds are dried in shade before sowing [12-15]. Osmopring is pre-sowing seed soaking in osmatic solutions containg polyethylene glycole (PEG-8000), urea or other high molecular weight compounds for 6-24 hours [16-18]. Seed priming with plant growth regulators or plant extracts containing plant growth promoters is also found to be effective in increasing crops germination and seedling establishment [19-25]. Moringa belongs to Moringaceae family and it is the only genus of this family [26]. Moringa (*Moringa oleifera* Lam.) is widely distributed in the Pacific region, sub-tropical regions and in West Africa [27]. It is also widely distributed in different agro-climatic regions of Pakistan. Moringa leaf extract (MLE) is considered to be rich with a veriety of

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natural plant growth regulators such as zeatin which belong to class of cytokinin and can be used as a source of cytokinins [28, 29]. It is also enriched with various macro-nutrients such as phosphorous and potassium along with micro-nutrients.

The objective of this study was to assess the comparative efficacy of different seed priming techniques such as hydropriming, on-farm priming, osmopriming, priming with moringa leaf extract and their effect on the germination and seedling growth of soybean.

MATERIALS AND METHODS

To evaluate the performance of different priming techniques in increasing the germination and seedling growth and development of soybean, a laboratoery trial was executed in allelopathy laboratory of Department of Agronomy, University of Agriculture Faisalabad (73.09°East Longitude, 31.25°North Latitude and at an altitude of 183 m above sea level), during 2009-10. The experimental was laid out in a complete randomized design (CRD) with three replications. Soybean (cv. Ajmiri) seeds were hydroprimed in distilled water for 12 hours, on-farm primed in tap water for 12 hours, osmoprimed in 0.5% urea solution for 12 hours and primmed in 5% moringa leaf extract (MLE) for 12 hours. A control treatment was kept for comparison. Eight seeds were sown in each pot on 13th of April, 2014. Time to start germination (days), time taken to 50% germination (days), final germiation (%), root length (cm), shoot length (cm), root fresh weight (g) and shoot fresh weight (f) were recorded during the course of this laboratory trial. The experiment was visited daily and the time was recorded as time to start emegence, when first seed was germinated. Time taken to 50% emergence was recorded by following the procedure suggested by Farooq *et al.* [30]

$$E50 = t_i + (N/2 - n_i)\,(t_j - t_i)\,(n_j - n_i)$$

where N is the final number of emerged seeds, n_i and n_j are number of emerged seeds at times t_i and t_j.

Protocol for Moringa Leaf Extract (MLE) Preparation: Moringa leaf extract (MLE) was prepared by collecting young and disease free leaves from Moringa tree. Theses leaves were washed and then frozen for two days in refrigerator at 4°C. Leaves were grinded in a manual juicer to extract the leaf juice. The juice was collected and filtered by passing through a muslin cloth to remove all the green matter. Aqueous Moringa leaf extract (100%) was diluted with distilled water to prepare solution of 5% concentration (v/v) as an experimental treatment. The leaf extract of Moringa was stored at room temperature for future use.

Statical Analysis: The data collected were subjected to statistical analysis using MSTAT-C computer software program [31] by employing Fisher's analysis of variance technique and treatment means were compared by using least significant difference (LSD) test at 5% probability level [32].

RESULTS AND DISCUSSION

Time Taken To Start Emergence (Days): Time taken to emergence indicates the viability and robustness of seeds as more vigorous seeds tend to emerge earlier when soil and environmental conditions are conductive to germination. The minimum time taken to start emergence (1.23 days) was recorded in pots in which Moringa leaf extract (MLE) treated seeds were sown and it was statistically at par with seeds that were hydro primed for 12 hours (1.32 days) (Fig. 1). The maximum time to start emergence (2.2 days) was taken by seeds that were not subjected to any priming technique (control). Even osmopriming performed better than control but it was much less significant than hydro priming, priming with Moringa leaf extract and on-farm priming. This was might be due to better water imbibition due to hydro priming and priming with Moringa leaf extract (MLE), because soybean seeds have a thick outer coat and they might take more time to start germination if sown unprimed because water imbibition is the first step of germination and insufficient moisture level hampers the germination process. These results are in agreement with those obtained by Iqbal [33] and Iqbal *et al.* [34], who recorded positive effects of Moringa leaf extract (MLE) on growth of plants.

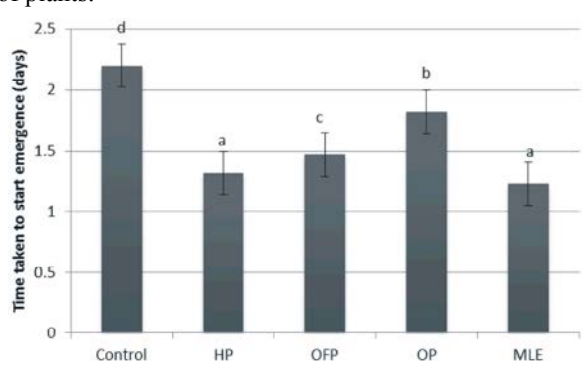

Fig. 1: Time taken to start emergence (days) of soybean as affected by different priming techniques.

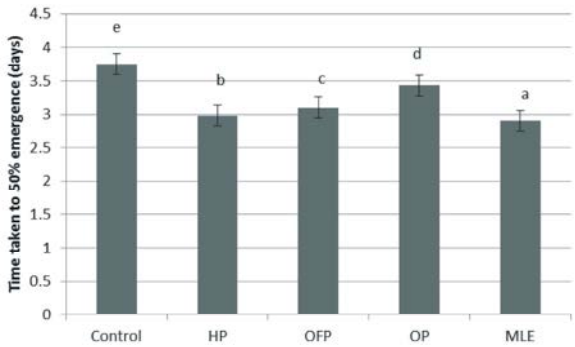

Fig. 2: Time taken to 50% emergence (days) of soybean as affected by different priming techniques.

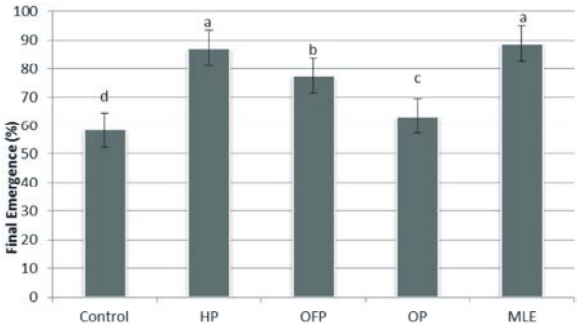

Fig. 3: Final emergence (%) of soybean as affected by different priming techniques.

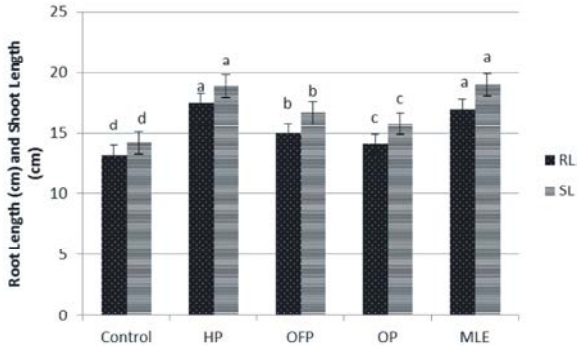

Fig. 4: Root and shoot length (cm) of soybean as affected by different priming techniques.

Time Taken To 50% Emergence (Days): Time taken to 50% emergence shows the time when half of the seeds have been germinated. The minimum time taken to 50% emergence (2.81 days) was recorded in pots in which Moringa leaf extract (MLE) treated seeds were sown and it was followed by seeds that were hydro primed for 12 hours (2.98 days) (Fig. 2). The maximum time to 50% emergence (3.75 days) was taken by seeds that were not subjected to any priming technique (control) as even on-farm priming and osmopriming performed better than control but these were much less significant than hydro priming and priming with Moringa leaf extract. The significantly less time taken to 50% emergence was might be due to better metabolic activity within the seeds that were treated moringa leaf extract (MLE). These results are in line with those obtained by Iqbal *et al.* [35] and Phiri [36], who concluded that Moringa leaf extract has the potential to increase the rate germination process by increasing the metabolic activity of seeds.

Final Germination (%): Final germination represents the number seeds that have been germinated in relation to total number of seeds that were sown and is expressed in percentage. Fig. 3 revealed that seed priming with Moringa leaf extract (MLE) was instrumental in increasing the final emergence of soybean as it recorded the maximum final germination (88.9%) and it was statistically at par with seeds that were hydro primed for 12 hours (87.2%). The minimum final germination was given by control treatment (58.5%). On-farm priming performed better than osmopriming and osmopriming gave higher final germination as compared to control treatment. The significantly higher final germination given by Moringa leaf extract was might be due to zeatin which is a natural plant growth regulator and other nutrients present in Moringa leaf extract [37]. These results are in complete confirmation with those of Phiri and Mbewe [38], who observed more germination and seedling growth triggered by zeatin.

Root Length (cm) and Shoot Length (cm): Root and shoot length are important indicators of robust seedling establishment because less number and shorter roots along with weak seedling shoots are unable to cope with even a minor stress and ultimately result in declining of crops yield. Hydro priming and priming with Moringa leaf extract (MLE) gave significantly higher root and shoot length and were statistically at par with each other. The maximum root length (17.5 cm) was given by Moringa leaf extract priming and it was statistically at par with root length (17 cm) given by hydro priming (Fig. 4). The minimum root length (13.2 cm) was recorded by control treatment that was much less than all other priming techniques. Similarly the highest shoot length (19 cm) was given by seeds that were treated with 5% Moringa leaf extract and it was statistically at par with shoot length (18.9 cm) given by pots in which hydro primed seeds were sown (Fig. 4). The significantly higher root length recorded by Moringa leaf extract was might be due to the presence of various growth promoters as well as macro and micro nutrients in Moringa leaf extract.

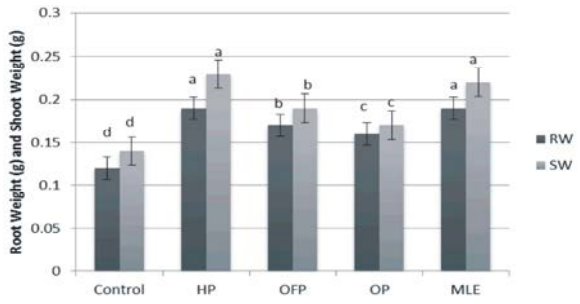

Fig. 5: Root and shoot weight (g) of soybean as affected by different priming techniques.

These results are in line as described by Yasmeen *et al.* [39], who found Moringa leaf extract quite effective in increasing the seedling growth and development of crops.

Root Weight (g) and Shoot Weight (g): Fig. 5 reveals that the highest root weight (0.19 g) was recorded by Moringa leaf extract (MLE) priming which was statistically at par with root weight (0.19 g) given by hydro priming. Similarly the highest shoot weight (0.23 g) was again observed in priming with Moringa leaf extract which was statistically at par with shoot weight (0.22 g) given by hydro priming. The significantly higher root and shoot weight given by Moringa leaf extract was might be due the action of zeatin which is a natural growth promoting substance belong to the class of cytokinins. These findings are in accordance with those reported by Iqbal [40] and Iqbal [41], who found zeatin effective in increasing crops growth and yield.

CONCLUSION

Thus seed priming with Moringa leaf extract (MLE) has the potential to give significantly higher final germination as well as seedling growth and development is also enhanced by plant growth regulators, micro and macro nutrients present in the Moringa leaf extract. It is also worth mentioning that hydro priming was also found to be equally effective in increasing germination and seedling growth of soybean. The fact of matter is that both of these priming techniques are quite simple to use for farming community, economical as well as environment friendly and can be used as a seed invigoration tool for soybean which continues to suffer low yield due to poor germination.

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