International Scholars Journals

African Journal of Agriculture ISSN 2375-1134 Vol. 7 (11), pp. 001-003, November, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Short Communication

Seed coating of safflower (*Carthamus tinctorius* L.) in order to delay germination

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Accepted 25 April, 2020

The idea tested was the restriction of water uptake as a means of influencing the germination rate of the coated seed. This led to the choice of an acrylic plastic polymer to be used as coating material. Assembled spinning disc equipment was used for coating the seeds. The germination tests of the coated seeds were performed in Petri dishes in a randomized complete blocks design with five replications. With increasing coating times in different polymer concentration, there was a decrease in germination rates in the first 5 days to at least 5%. It is concluded that two times application of 150 g/l acrylic plastic polymer in alcohol was the best treatment for delay of safflower germination in controlled conditions.

Key words: Delayed germination, hydrophobic polymers, safflower.

INTRODUCTION

No oilseed crop is better adapted than safflower (*Carthamus tinctorius* L.) to the low rainfall and stress conditions of cold dry lands. Safflower is much more drought tolerant than all other oilseed crops and most cultivated crops (Rashid et al., 2002). Furthermore, it can increase the sustainability of farming systems by acting as a disease-break in a rainfed area that is mainly devoted to cereals. In addition, it is possible that due to deep rooting, safflower can take up nutrients and moisture from sub-soil which can result in balanced absorption of soil minerals from different layers under dryland conditions.

The main problem in cultivating safflower in drylands in general and specifically in cold areas is that spring planting cannot produce the actual potential of this crop due to short growing period and terminal drought stress. In winter sowing, all plantlets die because of deep frost. It seems that seed coating can help the seed to survive in soil, during winter when the conditions for germination are not suitable, until the spring when the seeds should germinate to establish a crop stand.

Various coating treatments have been reported in literature to delay the germination of the seeds (Sauve and Shiel, 1980; Langan and Christie, 1985; Pamuk, 2001). Clayton et al. (2004) reported practices, where late to very late autumn-sowing of uncoated and coated rapeseed was compared. The objective of almost all of these treatments is to contribute the seed to survive a period in soil when the conditions for germination are poor, until such a time when the seeds should germinate to establish a crop stand. Sowing seeds during autumn, when sowing is practically possible, but in a way that will guarantee the early spring of seed germination when sowing is practically impossible due to wet soil, is a typical case in point. During fall and winter, the seeds should remain dry and metabolically inactive, because imbibed seeds or seedlings are damaged from cold and freezing. However, with change of conditions in the spring, the seeds should start to germinate. The possible early establishment of the crops in this way gives plants a significantly longer growing period and leads to a higher yield, finally.

The restrictions to spring-sowing and the potentiality of late autumn-sowing have initiated recurring efforts to find solutions for delaying germination of the autumn-sown crops, especially in cold areas where the winters are too severe for common winter crops. Several patents for the production of coated seeds for delayed germination have been generated (Watts and Schreiber, 1974; Watts, 1976; Langan and Christie, 1985; Kojimoto et al., 1989). Most of the researchers used hydrophobic or water-resistant polymers by themselves or in combination with other materials. The results demonstrated that emergence percentage could be increased with coating, whereas, uncoated seeds usually failed to produce seedlings in spring. Watts and Schreiber (1974) reported

Table 1. Analysis of variance for different coating treatments on safflower.

Source of var.	df	MS		
		D1	D2	D3
Treatments	8	4013.83**	2306.25 ns	1574.04**
Replications	2	371.44	36.11	64.04
Error	16	226.03	102.78	80.70

D1, D2 and D3 are 5, 10 and 15 days after beginning of germination test, respectively.
** and ns are significant at 1% level and not significant, respectively.

Table 2. Mean germination rate (%) for different coating treatments.

Treatments (g/l-polymer-delivering times)	D1	D2	D3
Control (untreated)	**100**	**100**	**100**
50-1	80	93.3	98.3
50-2	87.1	100	100
50-3	70	90	88.3
100-1	90	98.3	98.3
100-2	56.7	80	80
100-3	73.3	91.7	95.7
150-1	6.7	50	70
150-2	4.7	36.7	40
150-3	2	30	46.7
LSD 5%	12.3	8.2	7.3

D1, D2 and D3 are 5, 10 and 15 days respectively after beginning of germination test.

reported that the autumn-sown treated rapeseed which germinated in spring, had a considerably higher yield than rapeseed sown at the same rate at the normal time in spring. The time between the sowing in autumn and emergence varies between 50 - 90 days. The length of the period for which the applied seed coating has actually delayed the water uptake is hard to estimate, as the

information on number of days below 0°C when no water uptake takes place, are not given (Stendahl, 2005). In most of the reports, materials used in order to delaying germination by slowing down imbibition appear to act by controlling the water permeability of seeds. I have not seen any published work on seed coating of safflower. The aim of this research was to see if delayed germination could be achieved by coating the safflower seeds with materials that would hamper the seed water uptake for some time.

MATERIALS AND METHODS

A commercial acrylic plastic polymer (Iran-lak) that is commonly used to seal walls prior to tiling was used as coating material. No further details of the formulation of this industrial polymer were available. Nine different treatments including a factorial of three different doses of polymer in ethanol (50, 100 and 150 g/l) and 3 levels of delivering (1, 2 and 3 times) were tested on local safflower (Isfahan local) seeds. Assembled spinning disc equipment was used for coating the seeds. This apparatus was made in Dryland Agricultural Research Institute of Iran and was composed of a cylindrical stainless steel bowl, a small electric motor with an axle and a 30 mm diameter disc attached at the end of the axle, which rotated at about 10000 rpm. Regulated compressed air from two nozzles placed within the bowl was used to intensify the seed movement during coating. An ordinary hair dryer mounted on a stand was used to hasten drying of the coated seeds. A syringe with an injection needle was used to deliver the emulsion of coating material (in ethanol) via the spinning disc to the seeds.

The germination tests of the coated seeds were performed in Petri dishes with filter paper (sterilized at 120°C for 20 min in dry oven just before putting seeds) in a randomized complete blocks design with three replications at room temperature (20°C). The Petri dishes were closed up along the brim with paraffin film to reduce the risk of contamination and losing water by evaporation.

The number of seeds which had been germinated in each Petri dish was recorded every 24 h until full germination. All statistical analyses were conducted on germination percent using SPSS software.

RESULTS AND DISCUSSION

Uncoated seeds were roughly germinated at first 5 days. The statistical analysis on treated seeds revealed significant differences in germination rates of seeds given different coating treatments (Table 1).

The germination patterns of the coated seeds showed that with increasing coating times in different polymer concentrations there was a decrease in germination rates in the first 5 days to at least 5% (Table 2).

At the lowest polymer concentration, there was no considerable difference between coating times needed to delay germination, so that there were no significant differences between one and two times of application for 50 g/l polymer in this experiment (Table 2). There was no significant difference between applications times of 150 g/L in the first 5 days (Table 2). However, regarding the results of 10 and 15 days after germination test, it was concluded that two times application of 150 g/L acrylic plastic polymer in alcohol was the best treatment for delaying safflower germination under controlled conditions. However, more should be done regarding different temperatures and testing the treated safflower germination at different conditions similar to fall/winter and testing the results in the field which were planned for later investigation.

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