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The Effect of Magnetic Field on Growth, Development and Yield of Safflower and Its Comparison with Others Treatments

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Abstract: The aim of this study, was to determine the effect of on-farm seed priming to different methods after sowing a morphological traits and yield. Experiment was carried out, with safflower seeds following seed treatment in laboratory conditions in 2007, using a randomized complete block with 5 replications. Seed treatment consisted of stationary magnetic field treatment with 72 mT strength for 10 min, hydro priming for 72 h and gibberellic acid with 50 ppm concentration for 8 h. The analogous groups were used as control. Seed treatment was conducted in the lab conditions. The experiment was planted in May 2 using IL111 safflower variety. Results showed that yield of produced plants from treated seeds by magnetic field and gibberellic acid was more than other treatments. The yield of magnetic field was four times of control yield. The difference between oil and protein percentage of treated seeds were significant, so that oil percent of seeds produced from treated by in stationary magnetic field was more than other treatments. Control seeds had lowest percentage oil. Protein percentage of seeds produced from hydro priming treatment was more the other treatments. The obtained results in this experiment indicate that magnetic field treatment might be suitable for safflower as compared with other treatment under condition similar to this experiment.

Key words: Magnetic, seed treatment, yield, oil percentage, safflower

INTRODUCTION

The past century was a rage of advanced chemical application such as gibberellic acid and salt solution in agriculture as well in other and different areas modern living and negative effects on food products and on the environment are commonly know. Agricultural sciences take an interest not only in the common and valued crop-forming factors, but also in those less expensive and generally underestimated, though more pro-ecological ones, such as ionizing, laser or ultra violet radiation and electric and magnetic fields. Stimulation of plants with magnetic field as a way of increase the quantity and quality of yields has caught interest of many scientists in the entire world. Therefore, many scientists believe that this century will be the age of biophysical method application the influence of physical factors on biological organisms affects the dielectric characteristics of biomembrans. The effects of magnetic field on living systems, particularly the effect on germination of seeds and growth of plants, have been the object of numerous researches. The first studies were conducted by Florez *et al*. (2005), who observed increases in the rate of elongation of wheat seedlings under magnetic conditions.

A number of research projects using different physical methods have been conducted to improve or control seeds germination and growth. Tomato seeds treatment by Ac electric field and Ac magnetic field for short time periods accelerates the percent germination (Moon and Sook, 2000).

In general, the enhancement of growth under magnetic field appears to have been confirmed by many scientists. The other ways of seed treatment is priming. Priming is botany and agriculture is a form of seed planting preparation, in which the seeds are pre-soaked before planting. Priming isn't a widely-used method yet, but as more researchers experiment and obtain favorable results in different plants.

Results showed that not only seed priming was effective in improving crop stants, but also there were many positive knock-on effects of faster emergence and more vigorous early growth. Priming was seed to promote

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earlier tillering in cereals earlier flowering and maturity and higher yield. These effects were noted in many crops and countries. Seed priming is demonstrably effective for a wide range of crops and environments, yet its promotion as a stand-alone technology has limitation, particularly for inclusion in government extension programs. Consequently, more emphasis was placed on using seed priming as one of a set of tools to address more fundamental short comings in cropping systems.

In India and Bangladesh have shown that large yield increases in chickpea are possible in farmer's conditions following priming with tiny amount of molybdenum. Similarly, Harris *et al.* (2004) have also shown that seeds can be effectively inoculations. Murungu *et al.* (2004) reported that seed priming in maize significantly improve crop establishment, growth and yield in semi-arid Zimbabwe. Plant regulators are organic compounds which, in small amounts, some how modify a given physiological plant process and rarely act alone, as the action of two or more of these compounds is necessary to produce a physiological affect. Gibberellins (GAs) as one of seed treatment ways in this study play an essential role in many aspects of plant growth and development, such as seed germination, stem elongation and flower development (Leite *et al.*, 2003; Yamaguchi and Kamiya, 2000). They are extensively used to manipulate flower formation and fruit set in horticultural plants. When applied at the pre-blooming stage, GAs decrease the number of flower and fruit set, probably by increasing vegetative mass which, in turn, share the photo assimilates with the fruit. This hypothesis is also sustained by King *et al.* (2000), who reported greater stem growth in fuschia bibrida and pharbitis nill, resulting in the inhibition of flowering. Gulnaz *et al.* (2004), reported wheat seed treatment by 2, 4-D increased salinity-tolerance and leading to enhanced yield in saline soil. Ozdemir *et al.* (2004) obtained similar results with rice seed treatment by 24-epiBL.

In this study, we tried to show differences between 3 methods of seed treatment and their effects on yield in order to offer a reliable basis for wide application in agriculture.

MATERIALS AND METHODS

Treatments: Safflower seeds provided from corporation development oil seeds. The treatments were carried out in a laboratory environment using the safflower IL111 cultivar. Germinating test according to the guidelines issued by the international seed testing association, with slight modification was carried out under laboratory condition to obtain the seed viability. Seeds had high viability (98%) and divided to 4 groups.

Seeds and magnetic treatment: First group of seeds before exposing to magnetic field are sowed for 5 h and subsequent surface-dried with paper towels and allowed to air dry for 20 min under room temperature. In final, seeds were subjected to magnetic treatment for ten minutes, with 72 mT strong.

Seeds and gibberellic acid treatment: Second group of seeds immersion for 8 h GA3 solution with concentration 50 ppm.

Seeds and hydro priming: The other groups of seeds were placed in an aquarium for 72 h in conditions that relative humidity and temperature were 100 and 20%, respectively. After treatment increased mc (moisture content) of seeds. The analogous groups were used as control. Treated seeds were cultured in farm.

Experimental design and cultural details: Farm was divided in 4 fields. These were cultivated after rainfall in the first week of May, 2007. Fields were adjacent to each other. Ammonium phosphate treated the soil. Each field was divided in to four plots, each 3×5 m. On 2nd May, treated seeds of safflower were placed on culture rows. One, chosen at random, of each pair of plots was sown with seeds that had been treated and the germination was observed and recorded. Twenty one days after sowing urea rowly was given to under plants. One month after emergence, in 3-4 foliar stage small seedlings were palled out and received to desirable densits.

Measurements

Plant morphological characteristics: The number of plants in 1 m^2 of each plot was harvested in order to study safflower morphological characteristics. Morphological characteristics were including sprouting rate, length and diameter of shoot, number and length of primary branches, the number and length of second branches, distance between ground level and the first branch.

Components of yield: As safflower is a determinate crop, heads were harvested as they matured and dried. The number of heads in 2 rows of each plot was harvested.

Components of yield including number of heads, number of seeds per head and 1000 seed weight were counted. Total biomass was weighted then heads were separated and weights. Heads were threshed by hand and the weight of seeds recorded.

Statistical analysis: Statistical analysis was accomplished by means of average values and was performed using LSD experiment. Data were subjected to Analysis of Variance (ANOVA) by software, SAS and MATATC as completely randomized block design.

RESULTS AND DISCUSSION

Analysis of safflower morphological characteristics: Enough morphological characteristics length of secondary branches, sprouting rate and diameter of shoot were significant. Significantly, effective of GA3 and hydro priming treatment was negative on length of secondary branches. Magnetic field treatment caused increased length of secondary branches, while even though an increase in the number of leaves and branches was verified after treatment with GA_3 on bean plants and vicia faba (Kumar *et al*., 2004), similar results weren't obtained in present research for safflower. One of the possible explanations could be the different cultivars utilized by the various authors, as demonstrated, utilized 18 different cultivars and observed increase in germination in some and alack of sensitivity in other, under similar treatment (Leite *et al*., 2003). While, the diameter of shoot was 0.558 cm in control group, this rate increased in all treatment experiments and this rate raised up to 0.76, 0.6 and 0.7 cm, respectively in the magnetic field, GA3 and hydro priming ($p<= 0.05$).

Meiqiang *et al*. (2005) recorded that in different strings of magnetized plasma the sprouting percentage of 1.5 a treatment was 28% higher than the control seed and the 2 a treatment was 8% higher than the control. These values may explain the stimulating effects of magnetized plasma and its roles in alleviating damage by diseases and pests.

The effect of seed treatment on safflower yield: The effects of seed treatment were more pronounced in components of yield and yield. As it shown in Table 1, different intensities of magnetic field had obvious effects on the seed yield ($p<= 0.01$). The improved yield was mainly contributed by the number of head and number of seed per head, which were 13.19 and 42.4, respectively. Effects of GA3 and hydro priming were equally in number of head. The number of head of GA3 and hydro priming were increased 143% comparison with control groups.

The yield of magnetic field treatment was more than other yield treatments. The number of seeds per heads of pre-treated seeds by magnetic field, GA3 and hydro priming were, respectively 1.79, 1.48 and 1.56 times more than control. As it has been shown, magnetic field has had most effective on number of seeds per heads. These results show that rate of assimilations produce and collective capacity is increased by magnetic field. The 1000 seed weight showed a significant improvement due to treatment of seeds with magnetic field while, statistically there was no significantly difference in 1000 seed weight produced from GA3 and hydro priming with 1000 seed weight control. Variable electromagnetic field with different frequency in a macro trial with potato showed a yield increase up to 144%.

Ehsanzadeh and Abadi (2003) and Majde *et al*. (2002) were showed that three traits, number of seed/ capitulum's, number of capitulate/plant and 1000 seed weight could be used for selection of high seed yielding varieties as primary selection criteria investigation.

According to the results of Mokhtassi *et al*. (2006), high positive correlation coefficients with seed yield were found for total biomass, seed weight/capitulum's, capitulum's diameter, 1000 seed weight and flowering duration and stem yield, biomass, 100 seed weight, number of secondary branches, number of capitula/plant. Our results showed that there is high correlation between number of head per plant and number of seeds per heads with yield (Table 2).

The effect of pretreated seed on protein and oil percentage: Hydro priming improved protein rate of safflower seed, while effect of magnetic field and GA3 were same in protein rate of seed. Magnetic field had the most effective in increasing oil rate of seeds irrespective of GA3 and hydro priming had negative effective on oil

Table 1: Comparative investigated characteristics in three treatments in farm

Treatment	Sprouting rate (%)	Length of secondary branches	Diameter of shoot	No. head	No. seed/head	1000 seed weight	Seed yield (kg ha^{-1})	Oil (%)	Protein (%)
Magnetic field	79.72	18.650	0.740	13.190	42.40	59.930	4007	31.550	13.910
Hydro priming	88.80	14.530	0.704	9.134	35.08	50.700	2479	22.050	21.570
Gibberellic acid	80.52	6.330	0.600	9.110	36.89	46.720	3028	19.660	14.290
Control	69.92	18.700	0.558	6.340	23.56	46.170	1338	25.680	14.900
LSD (0.05)	12.10	2.425	0.115	1.692	5.630	6.752	4700	3.629	2.075

Table 2: Mean squares from analysis of variance of data for investigated traits of safflower

Source of variation	Degree of freedom	Sprouting rate (%)	Length of secondary branches	Diameter of shoot	No. head	No. seed/head	1000 seed weight	Seed yield (kg ha^{-1})	Oil (%)	Protein(%)
Block	4	284.057	2.244	0.025	2.163	18.878	18.223	179891.88	8.422	9.841
Treatments	3	298.500*	169.300**	0.036*	39.800**	313.500**	202.500**	6199458.30**	133.900**	65.700**
Error	12	77.158	3.097	0.007	1.507	16.695	24.012	116319.026	6.935	2.267

*, ** = significant at 0.05 and 0.01 statically levels, respectively

rate. The oil percentage of control seeds were more than gibberellic and hydro priming treatments. Crnobarac *et al.* (2002) showed an increase in yield of soybean from 5-25% with a higher quantity of oil and protein and at sunflower from 13.2-17.3%.

Rapid imbibitions of seeds during on-farm seed priming disrupt cell membranes and cause localized cell death in cotyledons and the embryonic axis of seeds and produce reactive oxygen species (Rashid *et al.*, 2004).

Arababian *et al.* (2001) reported that esterasis enzymes in pre-treated seed were increased by magnetic field during germination. The magnetic field reduces pH of cell wall and destroyed seed dormancy. The studies on the meristem cells of the plants show that magnetic field effects on normal cell metabolisms and also, impacts on the cell division.

In this study, we obtained positive effect of seed treatment on yield and components yield, but effect of these treatments is different in variety plants. For example, yield of spring wheat in general wasn't been favorable by magnetic field treatment (Kordas, 2002). Also, the application of 25 or 50 g ha^{-1} of GA reduced the average of seed yields but the 5 g ha^{-1} rate had no effect on yield (Leite *et al.*, 2003).

CONCLUSION

The obtained results in this study, indicate that magnetic field treatment might be suitable for safflower as compared with other treatment under condition similar to this experiment. In general, for using of pre-sowing treatment in safflower need to vastly examined, because various treatments differently effects on different seeds.

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