EFFECT OF DIFFERENT METHODS OF BREAKING SEED DORMANCY IN SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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ABSTRACT: The research was carried out to investigate best method for breaking seed dormancy of sunflower with different treatments in darkness and light. The germination percentage of sunflower was lower with all treatments in light as compared to darkness except 50ppm IAA and 0.5% KNO_3 soaking. The best root length was observed in darkness. Whereas, best shoot length was recorded in light as compared to darkness. The maximum root and shoot fresh & dry weights were observed with hot water (50°C) in the light. Hot water soaking slightly declined germination percentage but the best seedling growth was found with it. Tap water, 25% ethanol and 1.0% KNO_3 showed reasonable success in breaking of sunflower seed dormancy in darkness as compared to light.

INTRODUCTION:

Seed dormancy can be described as a viable seed can not germinate under ideal conditions [1]. For germination a seed must be viable, the environmental conditions should be conducive to growth and primary dormancy must be overcome. Primary seed dormancy is caused by exogenous and endogenous factors. Exogenous factors are those surrounding the seed. The most common exogenous type of seed dormancy is physical dormancy, or seed coat imposed that can be the result of seed coat impermeability to water or chemicals present in the seed coat. Sunflower achenes are prone to this form of dormancy [2, 3]. Methods used to overcome seed coat dormancy include soaking the seed in water, scarification and embryo excision. [4].

Endogenous factors affect the embryo that influences germination ability. Forms of endogenous dormancy are morphological and physiological. Morphological dormancy occurs due to the undeveloped seed's embryo is at the time of dispersal. The most common mechanism of primary dormancy is endogenous physiological dormancy. These seeds require a photoblastic (light/darkness), chilling stratification, or an after-ripening period to break dormancy [5]. The freshly harvested sunflower seeds (*Helianthus annuus*) present physiological dormancy localized at the embrionary axis which prevents germination at low temperatures. However, dormant embryos reach about 100% germination when incubated with the phytohormone ethylene during imbibitions [6]. The order and types of dormancy involved are dependent on the seed species. Dormant seeds can retain viability for days to decades depending on the species and the environment [7]. Phyto hormones are extremely important for the regulation of seed dormancy and germination [8, 9]. Chemicals such as KNO_3 [10] and hot water treatments have been recommended to overcome seed dormancy and enhance germination [11].The aim of this study was to assess the best method for breaking seed dormancy in Sunflower.

MATERIAL AND METHODS:

Seed dormancy breaking studies on sunflower genotype (Vulgare) were carried at Department of Crop Physiology, Sindh Agriculture University, Tandojam. Freshly harvested seeds of sunflower genotype were supplied by Oil Seeds Section, Agriculture Research Institute, Tandojam. The seeds were sterilized with 1% Sodium hypo chlorite for 5 min and washed under running water to remove sodium hypo chlorite. These sterilized seeds are treated with Zero soaking (Control), soaking in distilled, tap and hot water (50, 75 and 100 °C), 25% acetone, 25% ethanol, KNO_3 solution (0.5, 1.0 and 2.0%) and IAA solution (50 and 75 ppm) for 30 min. After treatments, ten seeds were placed between two layer of blotting paper for darkness and single layer of blotting paper for light experiments in Petri dishes saturated with 10ml of water and incubated at 25°C. The statistical design used was (factorial) complete randomized design, with three replications. For statistical analysis the data subjected to analysis of variance (ANOVA) by using software statistix 8.1. Significant differences among the mean values were compared by LSD test ($P< 0.05$). Germination was recorded very 24h interval and continued until no further germination occurred. Following observations were taken: such as germination percentage, root length (mm), shoot length (mm), and root fresh & dry weight (mg) and shoot fresh & dry weight (mg).

Germination percentage

Germination percentage was recorded after 120h and percentage was calculated by using the formula.

$$\text{Germination Percentage} = \frac{\text{Germinated Seeds}}{\text{Total Seeds}} \times 100$$

Root and shoot length

The root and shoot length was measured in millimeter with ruler after 120h of sowing.

Root and shoot fresh and dry weights

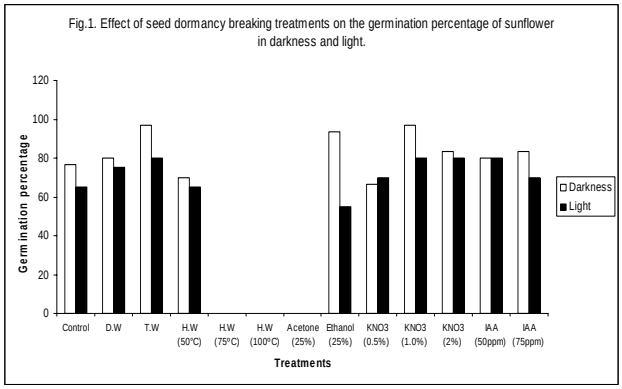
Roots and shoots were separated from seedlings and weighed in mg with an electronic digital balance. Roots and shoots were dried in hot air oven at 65°C for 48h and weighed again for dry weights.

RESULTS AND DISCUSSION

Germination Percentage

All treatments had a significant effect on the germination percentage of sunflower seeds (Fig. 1). In darkness, the highest germination percentage (96.66%) was recorded with tap water and 1% KNO_3 soaking for 30 min followed by 25% ethanol (93.33%). Germination percentage was slightly decreased with 0.5% KNO_3 and hot water at 50°C.

In light, germination percentage was slightly declined with all treatments except 50ppm IAA and 0.5% KNO_3 soaking as compared to darkness. However, zero germination percentage was recorded with hot water (75 and 100°C) and 25% acetone. Our results were in conformity with [12] were reported that in darkness, KNO_3 treated seeds enhanced germination of *H. aviculariifolium* in order to break exogenous seed dormancy due to presence of a chemical inhibitor in the capsule and seed coat, soaking in tap water is recommended. Singh and Rao [13] reported that 5mM KNO_3 solution doubled the germination rate of cultivated sunflower indicating that KNO_3 may influence the formation of free radicals, which in turn improve vigor. Adkins *et al.* [14] and Corbineau *et al.* [15] stated that ethanol have the capacity to break seed dormancy. Maiti *et al.* [16] stated that different techniques are used to break sunflower seed dormancy such as growth regulators, KNO_3 and priming. Pandey and Sinha [17] who stated that in India auxin have been used widely to break seed dormancy. Auxin at a very low concentration promotes germination but these effects are subjected to variation depending upon form and species of plant.

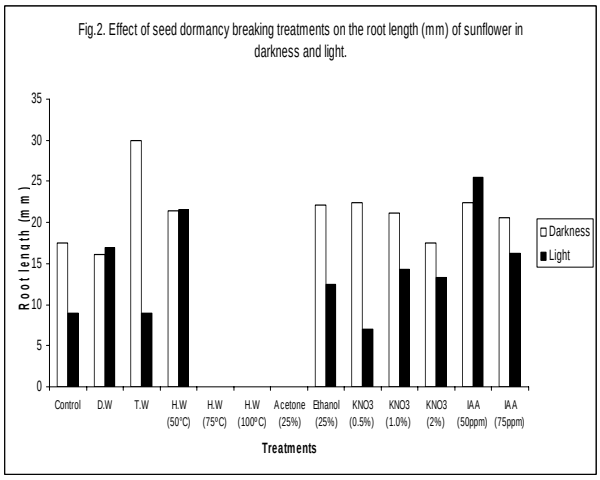


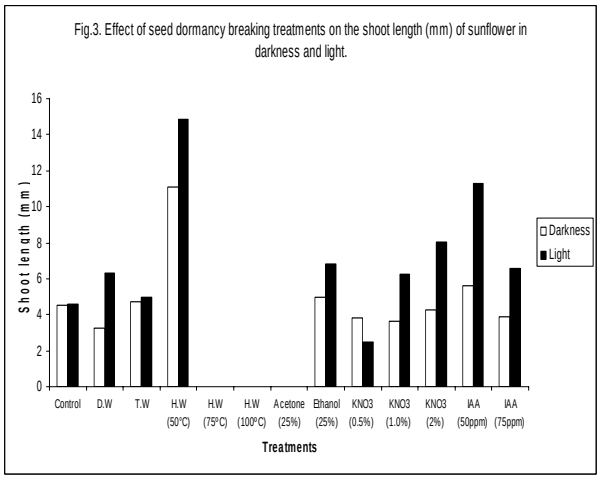
Root length

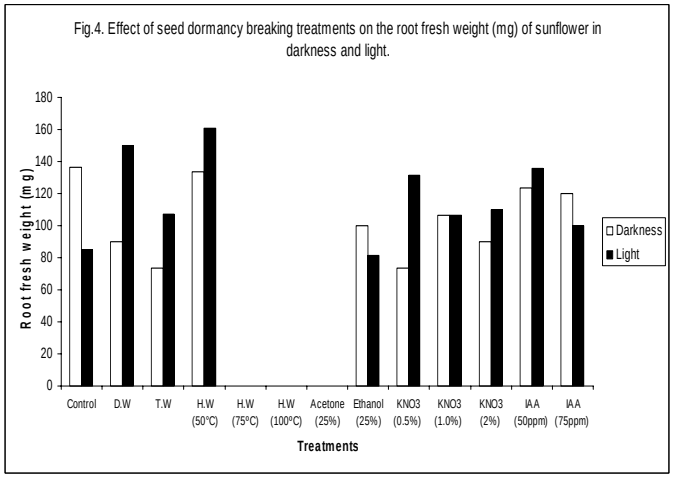
All the seed dormancy breaking treatments showed significant effects on root length under both darkness and light conditions (Fig. 2). In darkness, the maximum root length was recorded with tap water followed by 50ppm IAA, 0.5% KNO_3 and 25% ethanol soaking for 30 min. In light, the highest root length was observed with 50ppm IAA soaking and root length was slightly decreased with 0.5% KNO_3 as compared to control.

Shoot length

Shoot length was significantly affected by all treatments in darkness as well as light (Fig.3). The highest shoot length was recorded with hot water soaking at 50°C in both conditions because cotyledons were immediately exposed. Under light next to hot water soaking at 50°C, higher shoot length was observed in 50ppm IAA treatment.

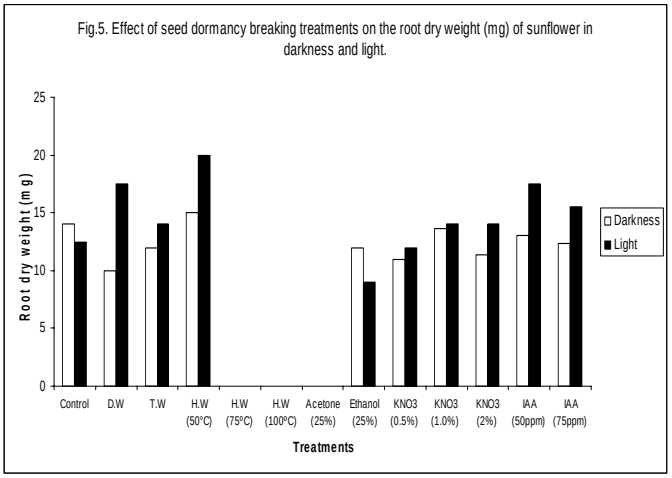






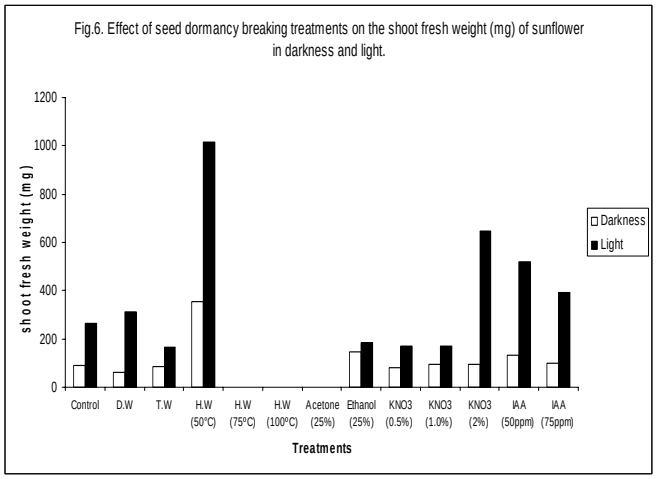
Root fresh and dry weight

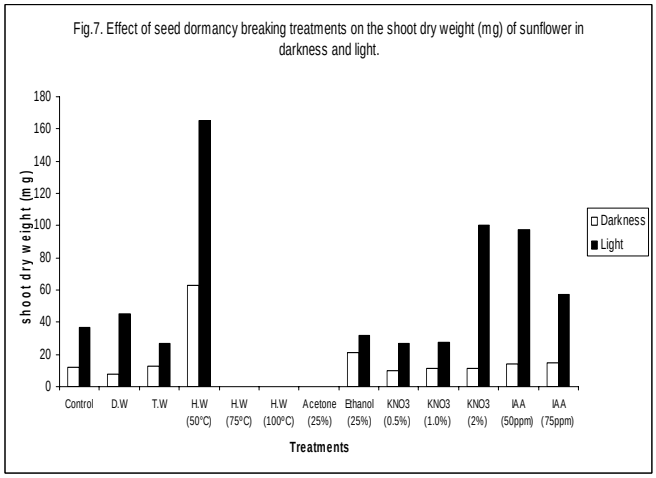
Seed treatments affected significantly fresh and dry weight in both conditions darkness and light (Fig. 4 and 5). All treatments failed to improve root fresh and dry weight in the darkness. Whereas, maximum root fresh and dry weight was observed in seeds treated with hot water at 50°C and distilled water soaking.



Shoot fresh and dry weight

All the seed dormancy breaking treatments showed significant effect on shoot fresh and dry weight under both darkness and light condition (Fig. 6 and 7). The highest Shoot fresh and dry weight was observed with hot water at 50°C in both darkness and light. The maximum shoot fresh and dry weight was recorded in light as compared to darkness.





hese results are in agreements with [8, 9] they reported that plant hormones are extremely important for the regulation of seed dormancy and germination. Taiz and Zeiger [18] reported that a minimum level of auxin needed for root growth whereas higher levels have inhibitory action. Tanimoto [19] stated that at relatively high concentrations, IAA decreases root elongation. Hooley [20] reported that auxin (IAA) is involved in the regulation of shoot elongation. Nasreen *et al.* [21] stated that seed coats, cotyledons and growth hormones play an important role in maintaining seed dormancy. Maiti *et al.* [22] stated that hot water is used to break sunflower seed dormancy. Alkinola *et al.* [23] reported that hot water is effective for breaking seed dormancy in wild sunflower. However, in our case, hot water treatments did not increase germination but increased root and shoot lengths and their fresh and dry weights.

CONCLUSION:

The research findings of the study show that *Helianthus annuus* seeds exhibit exogenous dormancy. Exogenous dormancy, originated from a chemical inhibitor is present in the seed coat and hard seed coat. Darkness produced a significant increase in germination compared to that of light. Zero germination was observed with hot water at 75 & 100°C and soaking with 25% acetone in darkness as well as in light. Only seedlings were green and healthier in light because the light allowed them to photosynthesize. In contrast, darkness grown seedlings were thin, unhealthier and yellow in color. The best root lengths were obtained in darkness method. Whereas, best shoot lengths were found in light method in comparison to darkness method. The maximum root and shoot fresh & dry weights were observed with hot water (50°C) in the light. Hot water slightly declined germination percentage but the best seedling growth was found with it. On the basis of findings it is suggested that the tap water, 25% ethanol and 1.0% KNO_3 are the best to break seed dormancy in sunflower in the darkness.

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