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Effect of seed priming and nitrogen levels on crop establishment and seedling growth of Sunflower (*Helianthus annuus* L.) in zero till conditions succeeding rice

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Abstract
Present Study was conducted to access the comparative performance of sunflower to seed priming and nitrogen management during *rabi* 2021. Significantly higher germination percentage (91.3%), germination index (28.7), seedling vigour index (1954) and lowest time to 50% seedling emergence (3 days) was recorded under osmopriming with KNO_3 @ 0.1% (M_3). The lower germination percentage (88.2%), germination index (20.5), seedling vigour index (1282), plant population and highest time to 50% seedling emergence (4.67 days) was recorded in M_1 in control. Significantly higher plant population were recorded under osmopriming with KNO_3 @ 0.1% (M_3) Initial (101,407) and Final (100,518), lowest was recorded under control. Incase of nitrogen management practices highest was recorded under application with 150% RDN Initial (101,343) and final (100509). All the seedling establishment traits were significantly affected with osmopriming @0.1% KNO_3.

Keywords: Seed priming, osmopriming, nitrogen management, seedling vigor index, germination index

Introduction
Sunflower (*Helianthus annuus* L.) is one of the main oil crops in the world. Globally, sunflower covers 27.4 M. ha with the productivity of 2049 kg ha^{-1} whereas, India cultivates sunflower in 0.226 M. ha with productivity of 1011 kg ha^{-1} and in Telangana, sunflower cultivated in an area of 0.007 M. ha with a productivity of 2342 kg ha^{-1} in 2020-21 (Indiastat 2021) [7]. The need to import vegetable oil in increasing amount is imposing a severe threat to economy. Now it is the need of the time to reduce our import of edible oil by increasing our domestic production. Edible oil in the country either comes from conventional (rapeseed, mustard, groundnut, sesame, linseed & cotton etc.) or non-conventional (soybean, safflower & sunflower) crops. Sunflower is drought tolerant crop and can grow under adverse conditions. Therefore, cultivation of sunflower crop has to be increased for supplementing the oil requirement. Crop production depends heavily on planting of high quality seeds. Rapid and uniform emergence is utmost important, because it is the foundation on which stand establishment is based and potential yield is determined. (Kausar *et al*., 2009) [8].
Nitrogen is the main nutrient that affects yield and seed quality of sunflower. Oil concentration determines the commercial quality of the seeds, while protein concentration is key to sunflower by-products. Increases of 1% in seed protein would generate increases of up to 5% in by-products. Nitrogen deficiency decreases leaf area and photosynthetic rate, and consequently radiation interception and use efficiency (Massignam *et al*., 2009) [9]. Adequate soil N availability is necessary to achieve high oil and protein concentration in the seeds; Application of nitrogen in three equal splits gave the highest yield, which was higher than that of basal or two equal splits (Reddy *et al*., 1996) [13].
Keeping this in view, the present study was undertaken to identify the best nitrogen application strategy and seed priming technique to attain maximum yield of sunflower.

Materials and Methods
The study was conducted at Krishi Vigyan Kendra, Palem, Nagarkurnool (District), Telangana during rabi season of 2021-22. The experiment was laid out in the split plot design with twelve treatments and replicated thrice.

Treatments included were 4 treatments of seed priming methods (i) M_1 = Control (no priming) (ii) M_2 = Hydropriming (iii) M_3 = Osmopriming with KNO_3 @0.1% (iv) M_4 = Osmopriming with NaCl @0.1% and 3 nitrogen management practices (i) S_1 = 100% RDN (ii) S_2 = 125% RDN (iii) S_3 = 150% RDN (RDN- Recommended Dose of Nitrogen).

Seed Priming

Hydropriming: Sunflower seeds were soaked in aerated distilled water for 12 hours and shade dried

Osmopriming: Sunflower seeds were soaked in aerated solutions of 0.1% KNO_3 and 0.1% NaCl.

Observations:

Germination percentage

Germination percentage was calculated using formula:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings germinated}}{\text{Total number of seeds placed for germination}} \times 100 \quad (1)$$

Vigour index

The seedling vigour index was calculated according to the following formula of Abdul-Baki and Anderson (1973) [1].

Seedling vigour index = (seedling length (cm) x Germination percentage (2)

Germination Index

Germination index was calculated using formula described by AOSA (1983) [2].

$$\text{Germination index} = \frac{\text{No. of germinated seeds}}{\text{Days of first count}} + \cdots\cdots + \frac{\text{No. of germinated seeds}}{\text{Days of final count}} \quad (3)$$

Time to 50% seedling emergence

The time to get 50% emergence was calculated according to the following formulae of Coolbear *et al*. (1984) [5] modified by Farooq *et al*. (2005) [6].

Data on agronomic traits viz., germination percentage, germination index, vigour index, time to 50% seedling emergence were recorded under laboratory conditions daily and the observations were recorded. Plant population was calculated using 1 m^2 quadrat and converted the population into 10000m^2.

Results and Discussions

Table 1: Crop establishment parameters of sunflower as influenced by seed priming methods.

Treatment	Germination percentage	Time to 50% seedling emergence	Germination index	Vigour index
Seed priming				
M_1	88.2	4.67	20.5	1282
M_2	89.2	4.11	24.0	1433
M_3	91.3	3.00	28.7	1954
M_4	89.5	3.33	26.0	1625
SE(m)	0.23	0.10	0.6	42
CD(p=0.05)	0.83	0.33	2.1	144

Germination percentage

The data regarding effect of seed priming and nitrogen levels on germination percentage was showed in Table 1. As it can be seen from the data, germination percentage increased with increased nitrogen levels along with priming. Significantly higher germination percentage was recorded in osmopriming with KNO_3 @ 0.1% M_3 (91.3%) followed by osmopriming with NaCl @ 0.1% M_4 (89.5 %) which is comparable with hydropriming (89.2%). Significantly lower germination percentage was obtained in control M_1 (88.2%). Osmopriming with KNO_3 @0.1% responded significantly better seed germination percentage over other treatments. The increased germination percentage might be due to seed priming may aid in breaking of dormancy, greater availability of germination substrates, which resulted in a rapid and energetic start (Yamauchi & Winn, 1996, Mwale *et al*. 2003 and Wahid *et al*. 2007) [12, 10, 11].

Germination index and Seedling vigour index

Significantly maximum germination index and seedling vigour index were obtained in Osmopriming with KNO_3 @ 0.1% (28.7, 1954) followed by osmopriming with NaCl @0.1% (26 & 1625) which is at par with hydropriming (24 & 1433) respectively and significantly lowest germination index and seedling vigour index was observed in control (20.5 & 1282) respectively. The results regarding effect of priming showed that osmopriming with KNO_3 @ 0.1% responded better in both germination index and seedling vigour index. (Table 1) seed priming results in reserve mobilisation of food materials, activation and resynthesis of certain enzymes, and enhanced DNA and RNA synthesis resulted in improved seedling vigour of primed seeds (Arif *et al*., 2008) [3].

Time to 50% seedling emergence

The effect of seed priming and nitrogen levels on time to 50% seedling emergence was presented in Table 1. Significantly lower time to 50% seedling emergence was recorded in Osmopriming with KNO_3 @ 0.1% (3 days) followed by osmopriming with NaCl @ 0.1% (3.78 days) which is comparable to hydropriming (4 days) and the highest time taken to emerge 50% seedlings were obtained in control (4.67 days). Osmopriming with KNO_3 @ 0.1% responded significantly better over other treatments and Similar positive response on time to 50% seedling emergence with seed priming as primed seeds had higher vigor levels which resulted in earlier start of emergence (Basra *et al*. 2002) [4].

Plant population as influenced by seed priming techniques and nitrogen levels

Table 2: Influence of seed priming techniques and nitrogen levels on plant population

Treatment	Initial plant population	Final plant population
Seed priming		
M_1	98,025	96,914
M_2	99,086	98,531
M_3	101,407	100,518
M_4	99,395	98,951
SEm±	356	238
CD (P=0.05)	914	839
Nitrogen levels		
S_1	97,778	97,028
S_2	99,315	98,648
S_3	101,343	100,509
SEm±	313	246
CD (P=0.05)	946	743
Interaction		
SEm±	572	412
CD (P=0.05)	NS	NS

Significantly higher plant population initial and final was realized in osmopriming with KNO_3 @ 0.1% (101407 & 100518) followed by osmopriming with NaCl @ 0.1% (99395 & 98951) which is at par with Hydropriming (99086 & 98531) respectively. Significantly lowest initial (98025) & final (96914) final plant population was recorded under control. Improve plant population is probably the result of higher germination percentage and seedling vigour index with seed priming.

Incase of nitrogen levels, 150% RDN (101343) initial & (100509) final plant population recorded significantly higher over 100% RDN and 125% RDN.

Conclusion

Comparing osmopriming with KNO_3 @ 0.1% to other seed priming techniques, it can be said that osmopriming with KNO_3 @ 0.1% was more effective in obtaining better germination percentage, germination index, seedling vigour index and higher plant stand which inturn increases the seed yields and high net returns.

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