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Response of Seed Priming and Nitrogen Levels on Yield and Yield Attributes of Zero Till Sunflower (*Helianthus annuus* L.) Succeeding Rice

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To determine the response of seed priming and nitrogen levels on yield and yield attributes of sunflower under zero till conditions succeeding rice.

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Study Design: Split plot.
Place and Duration of Study: Krishi Vigyan Kendra, Palem, between December 2021 and March 2022.
Methodology: A field experiment was conducted at Krishi Vigyan Kendra, Palem, Nagarkurnool (District) during *rabi* 2021-22 to assess the effect of seed priming and nitrogen management on growth and yield of zero till sunflower (*Helianthus annuus* L.) succeeding rice. The experiment was assigned in twelve treatments, laid out in split plot design with three replications. 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 levels (i) S_1 = 100% RDN (ii) S_2 = 100% RDN (iii) S_3 = 150% RDN (RDN randomly placed in sub plots of the main plot.
Results: The results revealed that head diameter (16.4 cm), number of seeds per head (534), threshing percentage (79.0%) and seed yield (1961 kg ha^{-1}) of zero till sunflower was significantly higher in osmopriming of seeds with KNO_3 @ 0.1% over other treatments. Among nitrogen levels, head diameter (16.1 cm), number of seeds per head (551), threshing percentage (79.7%) and seed yield (1944 kg ha^{-1}) of zero till sunflower was significantly higher under with application of 150% RDN over 100% RDN and 125% RDN.
Conclusion: Adoption of seed priming with KNO_3 @ 0.1% for 12 hours and applying nitrogen @ 150% RDN improves the head diameter, number of seeds per head, threshing percentage which in turn increased the rabi sunflower seed yield under zero tilled conditions succeeding to rice.

Keywords: Seed priming; nitrogen; seed yield; sunflower.

1. INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the major oilseed crops of India occupies an important position in Indian agriculture being next to food grains as a farm commodity. It has been described as "drenched with sun-vitality" because the head follows the sun, ending up facing the west "to absorb the few last rays for the dying sun" [1]. 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 [2]. India importing huge quantities of edible oils which accounted for 40 per cent of the agricultural imports bill and three per cent of the overall import bill of the country. Therefore, it is highly desirable to supplement our oilseeds production through the cultivation of sunflower. Increase in sunflower area during rabi season is possible as irrigation potential was increased in Telangana enables the farmer's to go for second crop during rabi season succeeding kharif rice under zero tillage is one of the option for timely sowing of rabi crop and there by increased productivity. Sunflower can play a key role in meeting the shortage of edible oils in the country.

Stand establishment is of primary importance for optimizing field production of any crop plant especially under conservation tillage. At suboptimal environment conditions, poor seed germination and subsequently poor plant establishment is a common phenomenon. Rapid germination and emergence are essential for successful crop establishment, for which seed priming could play an important role. Seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield. Seed priming is employed for better crop stand and higher yields in a range of crops.

"Seed priming technology has twofold benefits: enhanced, rapid and uniform emergence, with high vigor and better yields in vegetables and floriculture [3] and some field crops" [4,5]. According to McDonald [6], "primed seeds acquire the potential to rapidly imbibe and revive the seed metabolism thus enhancing the germination rate". Sedghi et al. [7] found that "seed priming with sodium chloride or potassium nitrate improved the stand establishment and seedling growth of sunflower".

"Sunflower in India is grown on marginal lands with low organic matter and poor fertility status with inadequate application of major nutrients like nitrogen. As soils are low in organic carbon status there is a need to enhance application of nutrients either in organic or inorganic form for improving productivity. Nitrogen is the most important nutrient, which determines the growth of the sunflower crop and increases the amount of protein and the yield. Furthermore, nitrogen fertilizer application affects dry matter production

as well as nitrogen accumulation and partitioning into various parts of crop plants for the growth, development and other processes" [8]. Higher nitrogen doses improve photosynthesis process, increase leaf area and net digestion rates [9]. However, excessive nitrogen application may result in environmental pollution, imbalanced plant nutrition, decreased quality and increased production cost. Therefore, proper nitrogen doses should be selected so as to improve yield and quality but to prevent negative impacts on human and soil health.

2. MATERIALS AND METHODS

2.1 Experimental Site

The study was conducted at Krishi Vigyan Kendra, Palem, Nagarkurnool district of Telangana during *rabi* 2021-22. The experiment was laid out in split plot design replicated thrice. Treatments included were 4 treatments (main plot) 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 (sub plot) practices (i) S_1 = 100% RDN (ii) S_2 = 125% RDN (iii) S_3 = 150% RDN.

2.2 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 for 12 hours and after treatment, seeds were given three surface washings with distilled water and redried to original weight under shade at ambient air temperature.

Crop husbandry: The seeds were sown by dibbling method adopting a spacing of 45 cm X 20 cm. A uniform dose of 90 kg P_2O_5 and 30 Kg K_2O kg ha^{-1} were applied through single Super Phosphate and Muriate of Potash, respectively as basal and Nitrogen (Recommended Dose of Nitrogen – 75 kg ha^{-1}) was applied through Urea as per the treatments in split doses as half of the nitrogen as basal and remaining half in two equal splits at 30 and 50 DAS as top dressing. Borax spray was done uniformly @ 2g/l of water to capitulum at ray floret opening stage to improve seed set and seed filling.

Observations: Data on yield and yield attributes were recorded at harvest maturity following the standard procedures. Five plants were randomly selected from net plot area and tagged for recording various observations and data on various parameters were subjected to statistical analysis to draw the conclusions.

3. RESULTS AND DISCUSSION

The statistical analysis of the results indicated that, seed priming and nitrogen levels significantly influenced the yield and yield attributes of sunflower. The detailed results were mentioned below.

3.1 Head Diameter

Data indicated that, head diameter of sunflower was significantly influenced by seed priming methods and varied levels of nitrogen. Significantly higher head diameter (16.4 cm) was recorded with osmopriming of 0.1% KNO_3 over the other treatments followed by osmopriming of 0.1% NaCl (15.2 cm) and hydropriming (14.6 cm) which were comparable with each other and significantly superior over control (13.3 cm).

Among nitrogen levels, application of 150% RDN recorded significantly higher head diameter (16.1 cm) followed by 125% RDN (14.7 cm) and 100% RDN (13.7 cm). Higher rate of nitrogen application improved the growth and drymatter accumulation with increased leaf area and assimilation of photosynthates to the sink might have resulted in higher head diameter [10]. These results confirm the findings of Sadiq et al., [11] and Iqbal & Ashraf [12] have also the evidence regarding positive effects of nitrogen on head diameter of sunflower. The interaction effect of seed priming and different levels of nitrogen on head diameter of zero till sunflower was found to be non significant.

3.2 Number of Seeds per Head

Analysis of data (Table 1) revealed that, number of seeds per head in sunflower was significantly influenced by seed priming and varied levels of nitrogen. Significantly higher number of seeds per head (534) was recorded with osmopriming of 0.1% KNO_3 over the other treatments followed by osmopriming of 0.1 NaCl (523) and hydropriming (522) which were at par with each other and significantly superior over control (506). Among nitrogen levels, number of seeds per head in sunflower was significantly higher (551) with application of 150% RDN over the other nitrogen levels followed by 125% RDN (521) and 100% RDN (492) which were differed significantly.

Table 1. Effect of seed priming methods and nitrogen levels on yield attributes and yield of sunflower

Treatments	Head diameter (cm)	No. of seeds head^{-1}	Seed yield (kg ha^{-1})	Threshing percentage (%)
Seed priming				
M_1 - Control	13.3	506	1654	75.0
M_2 - Hydropriming	14.6	522	1857	76.9
M_3 - Osmopriming (0.1% KNO_3)	16.4	534	1961	79.0
M_4 - Osmopriming (0.1% NaCl)	15.2	523	1867	77.1
SEm±	0.3	3	25	0.5
CD (P=0.05)	1.1	9	87	1.8
Nitrogen levels				
S_1 -100% RDN	13.7	492	1724	74.6
S_2 -125% RDN	14.7	521	1837	76.8
S_3 -150% RDN	16.1	551	1944	79.7
SEm±	0.2	4	31	0.3
CD (P=0.05)	0.7	12	93	0.8
Interaction				
SEm±	0.5	8	56	0.7
CD (P=0.05)	NS	NS	NS	NS

Note: Cm- Centimeter, DAS-Days after sowing, NS- Non significant, RDN - Recommended Dose of Nitrogen – 75 kg ha^{-1}

3.3 Threshing Percentage

The data revealed that, threshing percentage in sunflower was significantly influenced by seed priming and different levels of nitrogen (Table 1). Results indicated that the threshing percentage (79.0%) recorded with osmopriming with KNO_3 @ 0.1% was significantly higher over the rest of the treatments followed by osmopriming with NaCl (77.1%) which was statistically at par with hydropriming (76.9%) and significantly superior over control (75.0%).

Application of 150% RDN recorded significantly higher threshing percentage (79.7%) over other levels of nitrogen followed by application of 125% RDN (76.8%) and statistically lowest threshing percentage (74.6%) was recorded with application of 100% RDN.

3.4 Seed Yield

Perusal of the data indicated that seed yield of sunflower was significantly influenced by seed priming and different levels of nitrogen (Table 1). Seed yield under osmopriming with KNO_3 @0.1% was significantly higher (1961 kg ha^{-1}) than the seed yield under osmopriming with NaCl @ 0.1% (1867 kg ha^{-1}) which was at par with Hydropriming (1857 kg ha^{-1}) and significantly lowest seed yield (1654 kg ha^{-1}) was recorded under control. Scrutiny of the data revealed that the significantly higher seed yield (1944 kg ha^{-1}) was obtained with application of 150% RDN over 125% RDN (1837 kg ha^{-1}) and 100% RDN (1724kg ha^{-1}). The higher seed yield under with 150% RDN might be due to favorable effect of nitrogen on growth attributes like plant height, increased head diameter, drymatter production per plant and its subsequent translocation towards sink improved the seed setting, filling and yield of sunflower. These results are in conformity with Deepika et al. [13]. The interaction effect of seed priming and different levels of nitrogen on seed yield of sunflower was found non-significant.

4. CONCLUSION

It was concluded that osmopriming with KNO_3 @0.1% for 12 hours and application 150% RDN resulted in significantly higher yield and yield attributes of sunflower grown under zero till conditions succeeding to rice.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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