



Impact of Seed Priming and Fertilizer Levels on Quality, Yield and Economics of *Rabi* Maize

**Khemendra Choudhary ^{a*}, Ramesh M. Pankhaniya ^b,
Mahendra Choudhary ^c, Raghuveer Choudhary ^d,
Akshay Pareek ^a, Ganesha Ram ^e
and Satya Narayan Gurjar ^f**

^a Department of Agronomy, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.

^b Department of Agronomy, N. M. College of Agriculture, NAU, Navsari-396450 (Gujarat), India.

^c Department of Agronomy, GB Pant University of Agriculture and Technology, Pantnagar-263145 (Uttarakhand), India.

^d Department of Agronomy, Junagadh Agricultural University, Junagadh- 362001(Gujarat), India.

^e Department of Agronomy, COA, Nagpur, PDKV, Akola- 440001(Maharashtra), India.

^f KVK, Hindaun City, Karauli, Agriculture University, Kota-322230 (Rajasthan), India.

Authors' contributions

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

Article Information

DOI: <https://doi.org/10.9734/jsrr/2024/v30i72190>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here:

<https://www.sdiarticle5.com/review-history/119641>

Original Research Article

Received: 01/05/2024

Accepted: 03/07/2024

Published: 05/07/2024

ABSTRACT

The present investigation was conducted during the *rabi* season of 2019-20 at College of Agriculture, NAU, Navsari to study the "Effect of seed priming and fertilizer levels on *rabi* maize under south Gujarat condition". The experiment was laid out in Randomized Block Design with

*Corresponding author: E-mail: khemendrachoudhary18@gmail.com;

Cite as: Choudhary, Khemendra, Ramesh M. Pankhaniya, Mahendra Choudhary, Raghuveer Choudhary, Akshay Pareek, Ganesha Ram, and Satya Narayan Gurjar. 2024. "Impact of Seed Priming and Fertilizer Levels on Quality, Yield and Economics of *Rabi* Maize". *Journal of Scientific Research and Reports* 30 (7):800-809. <https://doi.org/10.9734/jsrr/2024/v30i72190>.

factorial concept (FRBD) with ten treatment combinations consisting of two factors which consists seed priming, Control (No priming), Seed priming with water for 12 hrs., Seed priming with 0.5% KCl for 12 hrs., Seed priming with 0.5% KMnO_4 for 12 hrs., Seed priming with 0.5% KH_2PO_4 for 12 hrs and fertilizer levels, 75% RDF (112.5+45+00, N: P_2O_5 : K_2O kg/ha) and 100 RDF (150+60+00, N: P_2O_5 : K_2O kg/ha). Treatments are replicated three times. The result indicated Seed priming with 0.5% KH_2PO_4 for 12 hrs recorded significantly higher grain yield (46.75 q/ha), straw yield (85.43 q/ha), harvest index (35.23%), protein yield (567.20 kg/ha), net return (₹ 74618/ha) and B:C ratio (2.24) as compared to other treatments. In case of fertilizer levels recorded significantly higher grain yield (46.91 q/ha), straw yield (86.94 q/ha), harvest index (34.99%), protein content (12.41 %), protein yield (584.23 kg/ha), net return (₹74742/ha) and B:C ratio (2.33) in treatment of 100% RDF (150+60+00, N: P_2O_5 : K_2O kg/ha). Treatment combination S_5F_2 (KH_2PO_4 at 0.5 % for 12 hrs. with 100% RDF i.e., 150+60+00, N: P_2O_5 : K_2O kg/ha) recorded significantly higher grain yield (52.80q/ha), straw yield (91.14 q/ha), harvest index (36.68%), Protein yield (686.56 kg/ha) net return (₹86657/ha) and B:C ratio (2.56) as compared to other treatments. Thus a combination of Seed priming 0.5% KH_2PO_4 for 12 hrs with 100% RDF (150+60+00, N: P_2O_5 : K_2O kg/ha) helps in increasing grain yield, straw yield, harvest index, protein yield, net return and B:C ratio of *rabi* maize without negative influence on plant and the environment.

Keywords: Seed priming; fertilizer; yield; protein; B:C ratio; maize.

1. INTRODUCTION

Maize (*Zea mays* L.) is a significant cereal crop worldwide, following wheat and rice. Its importance extends beyond serving as human food and animal feed, as it finds wide industrial applications. Maize stands out as a versatile crop, adapting well to diverse agro-ecologies, and boasting the highest yield potential among food grain crops [1]. With global demand increasing due to its multifaceted uses in food, feed, and industry, we must enhance production efficiency using existing or fewer resources. New agricultural technologies hold great promise for meeting the growing needs of consumers worldwide. Known as the 'queen of cereals,' maize is cultivated year-round due to its photo-thermosensitive nature. While predominantly a *kharif* season crop, *rabi* maize has gained significant prominence in India's overall maize production in recent years.

Several factors influence the productivity of *rabi* maize, with fertilizer management being a critical determinant of growth and yield. Maize, an exhaustive crop, requires a comprehensive range of macro and micronutrients to achieve optimal growth and exploit its yield potential. Notably, nitrogen utilization efficiency is higher during the *rabi* season compared to the *kharif* season, primarily due to improved water management and reduced leaching losses, resulting in better fertilizer response. Consequently, substantial cost reductions in maize production during the *rabi* season are feasible. The specific quantity of fertilizers

needed depends on soil fertility and prior field management. Among the essential plant nutrients, nitrogen, phosphorus, and potassium play pivotal roles in shaping growth and yield. Nitrogen is essential for increasing crop production, serving as a constituent of protoplasm and chlorophyll. It plays a crucial role in the activity of every living cell. Similarly, phosphorus contributes to energy storage and transfer within the plant system. Additionally, phosphorus is a vital component of nucleic acids, phytins, phospholipids, and enzymes. Numerous studies have highlighted the positive impact of NPK fertilization on maize productivity [2-4].

Germination and seedling emergence represent critical stages in the plant life cycle. Inadequate seedling emergence and improper stand establishment pose significant challenges in crop production, especially in regions with limited rainfall. Small-scale farmers often lack the necessary resources for proper seedbed preparation, putting them at greater risk compared to their more progressive counterparts. Conversely, successful establishment enhances competitiveness against weeds, improves drought tolerance, increases yield, and eliminates the time-consuming need for costly re-sowing. It is widely accepted that priming enhances germination, reduces seedling emergence time, and promotes robust stand establishment. A technique to enhance germination rate and uniformity involves seed priming or the physiological advancement of seed lots. Seed priming is a pre-sowing treatment where seeds are soaked in water and

then dried back to storage moisture levels before planting. This method helps crop plants with stand stress factors like drought and pest damage, ultimately leading to increased crop yield [5]. 'Nutrient seed priming' is a technique where seeds are soaked in a nutrient solution instead of pure water. This approach aims to increase seed nutrient content while also improving seed quality for better germination and seedling establishment. The primary purpose of seed priming is to partially hydrate the seeds, initiating germination processes. When re-imbibed under normal or stress conditions, these primed seeds exhibit rapid germination. This simple and cost-effective hydration technique involves partially hydrating the seeds to the point where pre-germination metabolic activities begin without actual germination. The seeds are then re-dried until they reach a weight close to their original dry weight [6]. The purpose of this research is to investigate and assess the impact of seed priming techniques and varying levels of fertilization on the quality, yield, and economic aspects of *rabi* maize cultivation. By conducting this study, we aim to determine the optimal combination of seed priming methods and fertilizer levels that can enhance maize quality, increase yield productivity, and improve economic outcomes for farmers during the *rabi* season.

2. MATERIALS AND METHODS

2.1 Description of Experiment Site

The field experiment was conducted at B-block of Agronomy Farm, N. M. College of Agriculture, Navsari Agricultural University (NAU), Navsari during *rabi* season of 2019-20. Navsari Agricultural University campus is situated at 20°57' N latitude and 72°54' E longitude, with an altitude of 10 meters above sea level. The climate in this region features hot summers, moderately cold winters, and a warm humid monsoon season with heavy rainfall. Winter typically begins in the first week of November and extends until mid-February. The soil of the experimental plot exhibits an alkaline reaction, with dry soil appearing dark brown and having a clayey texture.

2.2 Treatments and Experimental Design

Total ten treatment combinations of two factors were evaluated as under Factor I- Seed priming (S) S1: Control (No priming), S2: Seed priming with water for 12 hrs, S3: Seed priming with 0.5% KCl for 12 hrs, S4: Seed priming with 0.5%

KMnO₄ for 12 hrs and S5: Seed priming with 0.5% KH₂PO₄ for 12 hrs. Factor II- Fertilizer levels (F) F1: 75% RDF (112.5+45+00 N: P₂O₅: K₂O kg/ha) F2: 100% RDF (150+60+00 N: P₂O₅: K₂O kg/ha). Common application of Bio compost 5 t/ha in every treatment combination. The experiment followed a Randomized Block Design (Factorial concept) with three replications, featuring plots of 6.0 m x5.0 m each.

2.3 Experimental Procedures and Field Management

Three chemicals (KCl, KMnO₄ and KH₂PO₄) used for seed priming. The solution of these chemicals prepares by dissolving 5g (of each chemical) per liter of distilled water separately to make 0.5% solution beside this treatment only water treatment also given with same quantity of water. Seeds of *rabi* maize were soaked in a prepared solution containing various chemicals separately for 12 hours. After soaking, the seeds were dried in the shade until the seed coat became dry [7]. The total quantity of phosphorus and half the quantity of nitrogen were applied as a basal dose, while the remaining half of the nitrogen was given as a split application three weeks after sowing. The nutrients were applied in the form of urea (46% N) and single superphosphate (16% P₂O₅), with a dose of 150+60+00 N: P₂O₅: K₂O kg/ha using the band placement method and varying doses according to the treatment.

The field was prepared using a tractor-drawn M.B. plough and planking, following the layout plan. For sowing, the recommended seed rate of 20 kg/ha was used. Seed quantities were measured for each plot, and various priming techniques were applied according to the treatment before manual sowing at a depth of 4-5 cm using line sowing. The crops received irrigation five times. After sowing, the first irrigation was provided to ensure proper germination. For effective weed control, manual weeding was performed at 30 days after sowing (DAS), along with inter cultivation using a mechanical weeder. Overall, the crop stand was satisfactory, and there were no instances of pest or disease attacks. As a preventive measure against maize stem borers, Carbofuran 3G was applied at a rate of 15 kg/ha at 20 DAS

2.4 Data Collected and Collecting Procedure

Cobs from all the plants in each net plot were individually harvested and sun-dried for

approximately 10 days. Once the cobs were completely dry, the grains were separated using wooden sticks. The resulting produce was then cleaned and weighed. To determine the total grain weight per plot, we summed the grain weight of five sample plants and converted it to a hectare basis. Additionally, after harvesting the cobs, the plants themselves were harvested separately from the net plot and allowed to sun-dry in the field for a similar duration. These dried plants were then bundled appropriately, and the straw yield per net plot was recorded. The total straw yield per net plot was calculated by adding the straw weight of five sample plants and converting it to a hectare basis. Finally, the harvest index was calculated using the following formula [8].

$$\text{Harvest index (\%)} = (\text{Economical yield (kg/ha)}) / (\text{Biological yield (kg/ha)}) \times 100$$

Protein content of seed was determined by multiplying nitrogen percentage with 6.25. Protein yield was computed by using following formulae:

$$\text{Protein yield (kg/ha)} = (\text{Protein content (\%)} \times \text{Drymatter yield (kg/ha)}) / 100$$

The expenses incurred for all cultivation operations, from preparatory tillage to threshing, including the costs of inputs such as seeds and fertilizers, were calculated based on prevailing market prices. Gross realization was determined using grain and straw yield per hectare for each treatment, considering market rates. The overall cost of cultivation accounted for land preparation, crop harvesting, and all associated inputs. Net realization per hectare was calculated by subtracting the total cultivation cost from the gross realization. The benefit-cost ratio (B:C ratio) was computed using the following formula.

$$\text{B: C Ratio} = \frac{\text{NET RETURN}}{\text{COST OF CULTIVATION}}$$

2.5 Statistical Analysis

Statistical analysis of the data on maize yield, quality, and economic aspects during the investigation followed the variance analysis technique described by Panse and Sukhatme [9]. The method employed for the Factorial Randomized Block design involved an analysis of variance, and treatment effects on all the studied characters were further compared using the 'F' test [10]. A significance level of five

percent was used to assess the results, and the critical difference (CD at 5%) value was calculated for treatments with significant differences.

3. RESULTS AND DISCUSSION

3.1 Grain Yield (q/ha)

Data delineated in Table 1 and depicted in Fig. 1 revealed the significant variation in grain yield due to seed priming and fertilizer levels treatments. Results showed that treatment S5 (46.75 q/ha) and F2 (46.91 q/ha) considerably enhanced the grain yield as compared to other treatment. Grain yield increases due to enhanced germination rates, reduced time for seedling emergence leading to improved stand establishment, increased plant population density, augmented number of leaves per plant, consistent periodic growth in plant height, elongation of cob length, and widening of cob girth. These factors collectively facilitate the deposition of greater amounts of photo-assimilates in key plant components. Similar results were also observed by Ali et al. [11] and Miraj et al. [12]. Nitrogen (N) serves as a primary structural component of cells, with increasing nitrogen levels, both vegetative and reproductive growth rates in plants increase, attributed to the expansion of the plant's assimilating surface and overall photosynthetic capacity. Physiologically, maize grain yield is primarily influenced by the interaction between source (photosynthesis) and sink (grain) dynamics, which is directly associated with nitrogen levels. Elevated nitrogen content correlates with higher grain yields. Adequate nitrogen availability throughout the growth period proves vital for various plant processes, including chlorophyll production, enzyme synthesis, and facilitation of potassium and phosphorus utilization. Similar results were also observed by Ali et al. [13].

3.2 Straw Yield (q/ha)

Data Table 1 and depicted in Fig. 1 revealed the significant difference in straw yield due to seed priming and fertilizer levels. Results delineated in showed that treatment S5 (85.43 q/ha) and F2 (86.94 q/ha) considerably enhanced the straw yield which was found to be statistically at par with treatment S3 (85.07 q/ha). Whereas, significantly lowest straw yield was recorded with control treatment (no priming) (80.67 q/ha.). Straw yield increases due to improves germination, reduces seedling emergence time

improves stand establishment, higher plant population, no. of leaves per plant, periodically plant height, which encouraged deposition of more photo-assimilates in key plant parts. Similar results were also observed by Ali et al. [11] and Miraj et al. [12]. Sufficient fertilizer dose favourable for vegetative growth and root development as they received adequate and sufficient nitrogen and phosphorus in proper amount at critical stage. As the results, the plant height and yield attributing characters improved through increased photosynthetic activity of leaves. Similar results were also observed by Ali et al. [11] and Miraj et al. [12].

3.3 Harvest Index (%)

Data delineated in Table 1 and depicted in Fig. 1 revealed the significant variation in harvest index due to seed priming and fertilizer treatments. Results showed that seed priming of maize by treatment S5 (35.23%) and fertilizer level treatment F2 (34.99 %) considerably higher harvest index. which was not found to be statistically at par with any treatment. Whereas, significantly lowest harvest index was recorded with control treatment (no priming) (33.43 %). higher harvest index due to higher grain and straw yield with treatment KH_2PO_4 . Similar results were also observed by Ali et al. [13].

3.4 Protein Content (%)

A data presented in Table 1 revealed that protein content (%) was found non-significant with seed priming. However, numerically higher protein content (12 %) was observed under the treatment S5 and lower protein content (11.27 %) was noted in treatment S1. The present findings are very similar with the findings of Singh et al. [14]. Protein content (%) was significantly higher (12.41 %) with application of treatment F2 as compared with treatment F1. Pal *et.al.* [15] found that each increase in fertilizer level linearly increased grain protein content. Due to N, it is a major constituent of proteins. The significant improvement in the phosphorus (P) nutrient status of plant parts (stover) may have led to increased synthesis of amino acids, proteins, and growth-promoting substances.

3.5 Protein Yield (kg/ha)

A data given in Table 1 revealed that protein yield (kg/ha) was significantly higher with the fertilizer level F2 (584.23 kg/ha) and seed priming S5 (567.20 kg/ha) which was found to be

statistically at par with treatment S3 (532.54 kg/ha). The higher protein yield can be attributed to increased nitrogen uptake. Nitrogen is a major constituent of amino acids, which are the building blocks of proteins. Additionally, nitrogen is part of DNA, RNA, and nucleic acids. The increased availability of nitrogen and its storage in the grain likely contributed to this effect. Since nitrogen is the principal component of proteins, the higher protein content in the kernel may be due to increased nitrogen uptake. The elevated fertilizer levels could also be linked to greater cellular protoplasm and increased protein yield. These findings align with previous studies by Singh et al., [14] and Khan et al., [16] in maize crops

3.6 Interaction Effect

The data in Table 3 revealed a significant interaction effect between seed priming and fertilizer levels on grain yield, straw yield, harvest index, and protein yield. Among the treatment combinations, S5F2 (52.80 q/ha grain yield, 91.14 q/ha straw yield, 36.68% harvest index, and 686.56 kg/ha protein yield) exhibited significantly higher values. Notably, Ali et al., [13] found that seed soaking with a 1% phosphorus solution (using KH_2PO_4) improved fertilizer use efficiency and increased yield and profit across various crops. These findings align with similar results reported by Patil et al., [17].

3.7 Effect on Economics

In Table 1, the data on the economics of *rabi* maize influenced by different seed priming and fertilizer levels are presented. The results indicate that the highest gross returns (₹107848/ha), net returns (₹74618/ha), and benefit-cost ratio (BCR) of 2.24 were achieved with seed priming treatment S5, followed by treatment S3. Similarly, the highest gross returns (₹108525/ha), net returns (₹74742/ha), and BCR of 2.21 were observed with fertilizer level treatment F2. Conversely, the lowest gross returns (₹94093/ha), net returns (₹61465/ha), and BCR of 1.88 were associated with treatment F1. These variations may be attributed to increased fertilizer levels, improved yield attributes, higher grain and straw yields. Raskar et al., [18] Thakur et al., [19].

3.8 Interaction Effect on Economics

Data presented in Table 3 revealed that higher gross returns ₹ 120465/ha, net returns ₹ 86657/ha and benefit: cost ratio (BCR) 2.56 obtained with treatment combination of S5F2

Table 1. Effect of various treatments on grain yield, straw yield, harvest index, protein content, protein yield and economics of *rabi* maize

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	HI (%)	Protein (%)	Protein yield (kg/ha)	Cost of cultivation (₹/ha)	Gross returns(₹/ha)	Net returns(₹/ha)	B:C ratio
Seed Priming (S)									
S1	40.54	80.67	33.43	11.27	457.13	32977	95170	62193	1.89
S2	41.40	82.40	33.43	11.6	481.20	33155	97204	64048	1.93
S3	44.86	85.07	34.46	11.8	532.54	33415	104276	70860	2.12
S4	43.86	83.59	34.36	11.75	518.48	33250	102049	68799	2.07
S5	46.75	85.43	35.23	12	567.20	33230	107848	74618	2.24
SEm±	0.18	0.27	0.092	0.24	12.54		383.15	383.15	0.011
C.D. at 5%	0.56	0.82	0.52	NS	37.27		1138.4	1138.4	0.034
Fertilizer Levels (F)									
F1	4005	7993	33.38	10.94	438.38	32628	94093	61465	1.88
F2	4691	8694	34.99	12.41	584.23	33783	108525	74742	2.21
SEm±	0.11	0.17	0.058	0.15	7.93		242.32	242.32	0.007
C.D. at 5%	0.35	0.52	0.174	0.46	23.57		720	720	0.021
S x F	S	S	S	NS	S		S	S	S

Where, HI- Harvest index, S1- Control, S2- Water, S3- KCl, S4- $KMnO_4$, S5- KH_2PO_4 , F1- 75% RDF, F2 -100% RDF, RDF: Recommended Dose of Fertilizer, B:C ratio – Benefit cost ratio, ₹- Indian rupee.

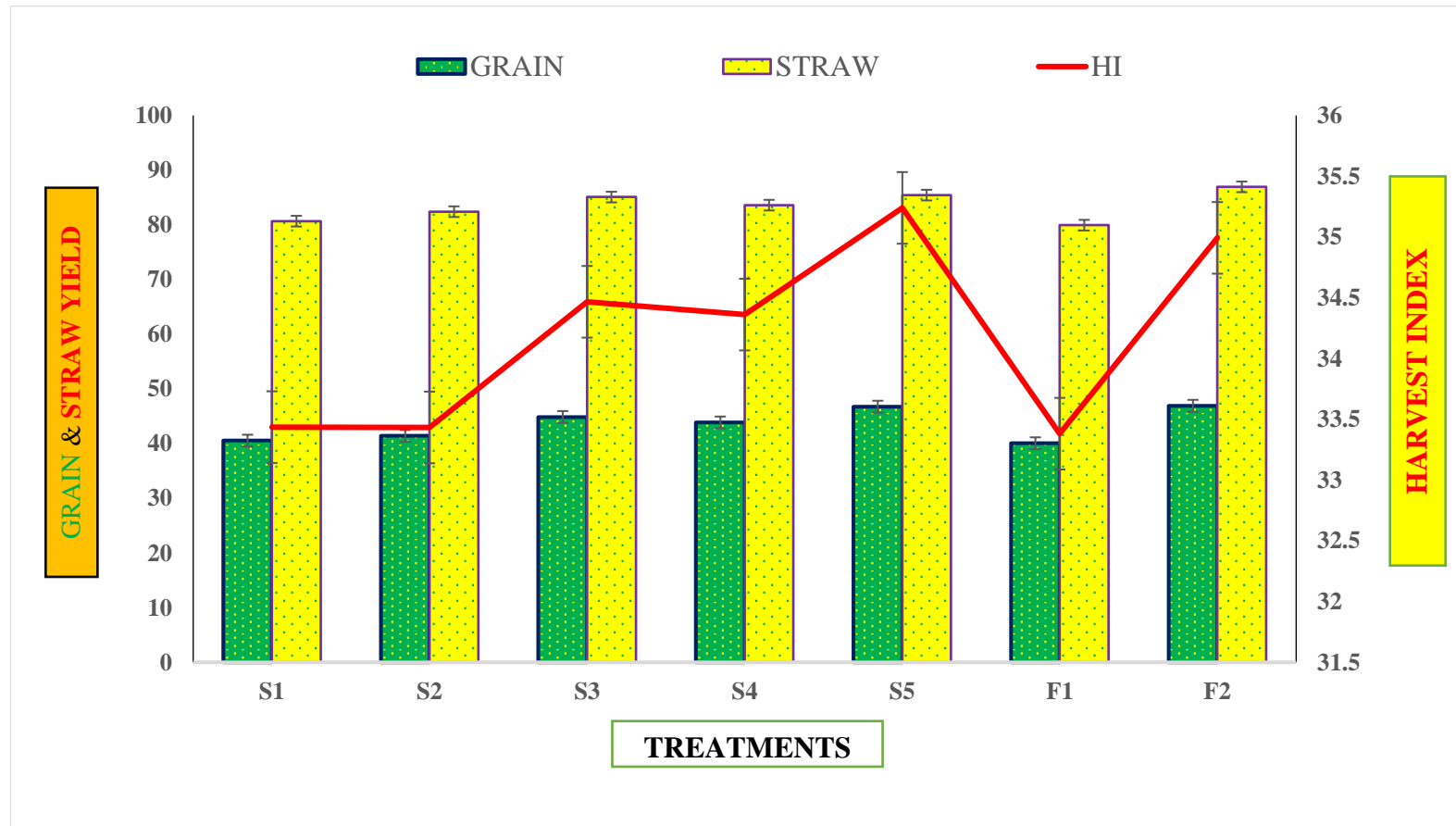


Fig. 1. Effect of various treatments on grain yield, straw yield and harvest index of maize

Table 2. Interaction Effect of various treatments on grain yield and straw yield of rabi maize crop

Treatments	Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)		Protein yield (kg/ha)	
	F1	F2	F1	F2	F1	F2	F1	F2
Seed Priming (S)	Fertilizer Levels (F)							
S1	39.09	41.98	79.49	81.86	32.97	33.90	424.37	489.88
S2	39.64	43.16	79.93	84.87	33.15	33.71	431.9	530.50
S3	40.69	49.04	80.73	89.42	33.52	35.42	447.66	617.43
S4	40.15	47.57	79.80	87.39	33.47	35.25	440.15	596.80
S5	40.70	52..80	79.72	91.14	33.80	36.68	447.83	686.56
SEm±	0.26		0.39		0.13		17.74	
C.D. at 5%	0.79		1.16		0.39		52.71	

Where, S1- Control, S2- Water, S3- KCl, S4- KMnO₄, S5-KH₂PO₄, F1- 75% RDF, F2 -100% RDF, RDF: Recommended Dose of Fertilizer.

Table-3. Effect of various treatments combinations on yield and economics of maize crop

Treatment	Yield (q/ha)		Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
	Grain	Straw				
S ₁ F ₁	39.09	79.49	32400	92201	59801	1.85
S ₁ F ₂	41.98	81.86	33555	98140	64585	1.92
S ₂ F ₁	39.64	79.93	32578	93330	60752	1.86
S ₂ F ₂	43.16	84.87	33733	101077	67344	2.00
S ₃ F ₁	40.69	80.73	32838	95471	62633	1.91
S ₃ F ₂	49.04	89.42	33993	113080	79087	2.33
S ₄ F ₁	40.15	79.80	32673	94234	61561	1.88
S ₄ F ₂	47.57	87.39	33828	109865	76037	2.25
S ₅ F ₁	40.70	79.72	32653	95232	62579	1.92
S ₅ F ₂	52.80	91.14	33808	120465	86657	2.56
SEm±	0.26	0.39				
C.D. at 5%	0.79	1.16				

Where, S - Seed priming, F- Fertilizer level, S1- Control, S2- Water, S3- KCl, S4- KMnO₄, S5-KH₂PO₄, F1- 75% RDF, F2 -100% RDF, B:C ratio – Benefit cost ratio, ₹- Indian rupee.

followed by treatment combination of S3F2 which secured ₹ 113080/ha gross returns, ₹ 79087 net returns and 2.33 benefit: cost ratio (BCR) [20-23]. However, the lowest gross returns ₹ 92201/ha net returns ₹ 59801/ha and benefit: cost ratio (BCR) 1.85 was noted with treatment combination of S1F1. It might be due to higher dose of nitrogen triggered the vigorous growth of plant and less competition for the nutrient [19].

4. CONCLUSION

On the basis of one year experimentation, it can be concluded that *rabi* maize seed primed with KH₂PO₄ at 0.5 % for 12 hrs. along with application of 100 % RDF (150+60+00 N: P₂O₅: K₂O kg/ha) and 5 t/ha Bio-compost for obtaining higher grain yield, straw yield, protein content, protein yield and net return under south Gujarat condition.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Choudhary K, Pankhaniya RM, Choudhary M, Pareek A, Choudhary R, Gurjar S, Ram G. Effect of Seed Priming and Fertilizer Levels on Growth, Yield Attributes and Yield of Rabi Maize. International Journal of Environment and Climate Change. 2024; 14(6):365-73.

2. Mehta YK, Shaktawat MS, Singh SM. Influence of sulphur, phosphorus and farmyard manure on yield attributes and yield of maize (*Zea mays* L.) in southern Rajasthan conditions. *Indian Journal of Agronomy*. 2005;50:203-205.
3. Rajanna AE, Ramachandrappa BK, Nanjappa HV, Soumya TM. Soil plant water status and yield of maize (*Zea mays* L.) as influenced by irrigation and fertility levels. *Mysore Journal of Agricultural Sciences*. 2006;40:74-82
4. Makwana ND, Thanki JD, Der PB, Nandaniya JK. Grain yield, nutrient uptake and economics of rabi maize under different fertilizer levels and organic sources in south Gujarat condition. *Advances in Life Sciences*. 2016;5(5): 1661-4.
5. Harris D, Joshi A, Khan PA, Gothkar P, Sodhi S. On farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in India using participatory methods, *Experimental Agriculture*. 1999;35:15-29
6. Casenave EC, Toselli ME. Hydro priming as a pre-treatment for cotton germination under thermal and water stress conditions. *Seed Science Technology*. 2007;35:88-98.
7. Sharma M, Parmar DK. Effect of seed priming with zinc sulfate on yield and quality parameters of rainfed maize-pea sequence under mid hill conditions of Himachal Pradesh. *Journal of Pharmacognosy and Phytochemistry*. 2018;7(1):1401-1407.
8. Donald CM, Hamblin J. The Biological Yield and Harvest Index of Cereals as Agronomic and Plant Breeding Criteria. *Advances in Agronomy*. 1976;28:361-405.
9. Panse VG, Sukhatme PV. *Statistical methods for Agricultural Workers*. ICAR, New Delhi. 1985;199-200.
10. Gomez KA, Gomez AA. *Statistical procedures for Agricultural Research*. A Willey Interscience Publication, John Willey and Sons., New York. 1984;108-127.
11. Ali AA, Iqbal A, Iqbal MA. Forage maize (*Zea mays* L.) germination, growth and yield gets triggered by different seed invigoration techniques. *World Journal of Agricultural Sciences*. 2016;12(2):97-104.
12. Miraj G, Shah HU, Arif M. Priming maize (*Zea mays*) seed with phosphate solutions improves seedling growth and yield. *The Journal of Animal and Plant Sciences*. 2013;23(3):893-899.
13. Ali M, Ullah Z, Mian IA, Khan N, Khan N, Adnan M, Saeed M. Response of maize to nitrogen levels and seed priming. *Journal of Pure and Applied Biology*. 2016;5(3): 578-587.
14. Singh SK, Singh RN, Ram US, Singh MK. Yield attributes, yield and economics of winter popcorn (*Zea mays everta* Sturt.) as influenced by planting time fertility level and plant population under late sown condition. *Journal of Applied and Natural Science*. 2016;8(3):1438 -1443.
15. Pal B, Hirpara DS, Vora VD, Vekariya PD, Sutaria GS, Akbari KN, Verma HP. Effect of nitrogen and phosphorus on yield and yield attributes of maize in south Saurashtra, India. *International Journal of Current Microbiology and Applied Sciences*. 2017;6(3):1945-1949.
16. Khan AA, Hussain A, Ganai MA, Sofi NR, Hussain ST. Yield, nutrient uptake and quality of sweet corn as influenced by transplanting dates and nitrogen levels. *Journal of Pharmacognosy and Phytochemistry*. 2018;7(2):3567-3571.
17. Patil PP, Shinde AK, Gadhave PM, Chavan AP, Mahadkar UV. Effect of sowing methods, nutrient management and seed priming on seed yield and yield attributes of finger millet (*Eleusine coracana* G.). *Advanced agricultural research & technology journal*. 2018;2(1):12-17.
18. Raskar SS, Sonani VV, Patil PA. Study of economics of maize as influenced by different levels of nitrogen, phosphorus and zinc. *International Journal of Scientific and Research Publications*. 2013;3(10): 1-3.
19. Thakur AK, Kumar P, Salam P, Patel RK, Netam CR. Effect of different sowing methods, nutrient management and seed priming on growth, yield attributing characters, yield and economics of finger millet (*Eleusine coracana* L.) at Baster plateau. *Journal of pure and applied microbiology*. 2016;10(1):407-415.
20. Shimelis, Fasil, Almaz Admasu, Zenebe Mulatu, Wogayehu Worku, Debela Bekele, and Dereje Dobocho. Response of Different Fertilizer Levels on Growth, Yield and Yield Components of Faba Bean (*Vicia Faba* L.) Varieties at Oromia Regional State, Ethiopia. *Asian Journal of*

- Advances in Agricultural Research. 2022; 18(1):1-8.
Available:<https://doi.org/10.9734/ajaar/2022/v18i130207>.
21. Abakura JB, Audu I. Effects of Nitrogen Fertilizer Rates and Soil Types on Yield and Yield Components of Maize (*Zea Mays* L.) in Yola, Adamawa State, Nigeria. Asian Journal of Agricultural and Horticultural Research. 2018;1(1):1-12.
Available:<https://doi.org/10.9734/AJAHR/2018/39488>.
22. Tóth G, Guicharnaud RA, Tóth B, Hermann T. Phosphorus levels in croplands of the European Union with implications for P fertilizer use. European Journal of Agronomy. 2014; 55:42-52.
23. Atafar Z, Mesdaghinia A, Nouri J, Homae M, Yunesian M, Ahmadimoghaddam M, Mahvi AH. Effect of fertilizer application on soil heavy metal concentration. Environmental monitoring and assessment. 2010;160:83-9.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/119641>