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Effectiveness of Seed Priming and Fertilizer Levels on Nutrient Available and Uptake in *Rabi* Maize

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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

The present investigation was conducted during the *rabi* season of 2019-20 at College of Agriculture, Navsari Agricultural University, Navsari, India. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) with ten treatment combinations

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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 NPK uptake in grain (90.75, 12.99, 36.27 kg/ha respectively), straw (59.96, 13.70, 111.25 kg/ha respectively), total uptake (150.71, 26.69, 147.52 kg/ha respectively) and available NP (207.0, 39.67 kg/ha respectively) in soil after harvest of crop as compared to other treatments. In case of fertilizer levels recorded significantly higher N content in grain (1.99%) and straw (0.73%), higher NPK uptake by grain (93.48, 12.95, 36.56 kg/ha, respectively) and straw (63.39, 13.70, 112.89 kg/ha, respectively), total uptake (63.39, 13.70, 112.89 kg/ha, respectively) and available NP (212.60, 40.73 kg/ha respectively) in soil after harvest of crop in treatment of 100% RDF (150+60+00, N: P_2O_5: K_2O kg/ha). Treatment combination S5F2: (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 N (109.9 kg/ha) uptake by grain and total N (178.21 kg/ha) uptake by crop 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 total NPK uptake in crop and available NP in soil after harvest of *rabi* maize without negative influence on plant and the environment.

Keywords: Fertilizer; maize; seed priming; treatment and uptake.

1. INTRODUCTION

Maize (*Zea mays* L.) is a significant cereal crop worldwide, following wheat and rice. It stands out as a versatile crop with wide adaptability across various agro-ecologies, boasting the highest yield potential among food grain crops. Emerging production technologies hold great promise for enhancing productivity to meet the increasing demands of global consumers. Over decades, corn growers have diligently pursued continuous improvement and greater efficiency. Maize, often referred to as the 'queen of cereals,' is cultivated year-round due to its photo-thermo-sensitive nature. While traditionally a *kharif* season crop, *rabi* maize has recently gained prominence in India's total maize production. In Gujarat state maize is grown in 2.82 lakh ha in kharif and 1.11 lakh ha in winter *rabi* with production of 8.26 lakh tones and productivity 2098 kg/ha during the year 2023-24 (indiastat.com). In India, 9.75 million tonnes of grain are produce from 1.75 million ha of *rabi* maize, with an average productivity rate of 5555kg/ha during the year 2023-2024 (indiastat.com). In world wide area and production of maize is about 197.18 million ha and 1134.70 million tonnes, respectively with productivity of about 5755 kg/ha during the year 2017-18 [1].

Maize serves not only as a vital food source for humans and livestock but also finds applications in various industries. The yield potential of a crop depends significantly on its genetic makeup and the environmental conditions in which it grows. By optimizing favorable growth environments, we can fully exploit the genetic potential. Fortunately, our country's existing climatic conditions and maize varieties are conducive to increased production. Fertilizers play a crucial role, contributing 40-45 percent to maize yield [2]. Properly balanced and optimized use of nitrogen, phosphorus, and potassium is essential for maximizing cereal yields. Although our current maize varieties have high yield potential, certain production constraints have hindered their full exploration. Among the essential plant nutrients, primary elements such as nitrogen, phosphorus, and potassium play a crucial role in determining growth and yield. Nitrogen, in particular, is often deficient in Indian soils. Crop responses to nitrogen vary significantly based on soil fertility levels and environmental conditions [3]. Nitrogen is a fundamental building block for organic metabolites, including nucleic acids, proteins, and phytochromes, making it essential for plant composition [4]. It constitutes to 4% of the dry matter in plants and influences the utilization of other elements like phosphorus and potassium [5]. Crops grown in nitrogen-deficient soils exhibit distinct symptoms such as poor growth, chlorosis, and necrosis, affecting various physiological and biochemical characteristics [5]. To enhance crop productivity, the use of nitrogen fertilizers, along with other nutrients, has been recommended [6,7]. additionally, phosphorus stimulates root system development, contributing to rapid maize growth and early maturity.

Germination and seedling emergence represent critical stages in the plant life cycle. In regions with limited rainfall, insufficient seedling emergence and improper stand establishment pose significant challenges for crop production. Among various agronomic factors, seed priming plays a crucial role in enhancing *rabi* maize yield. Seed priming involves soaking seeds in plain water before sowing, which accelerates germination and ensures uniform emergence. This practice leads to better crop stands and stimulates vigorous seedling growth. Hydro priming, a simple hydration technique that triggers pre germination metabolic processes without actual germination [8] offers an effective, economical, and short-term solution to combat drought [9] effects and other abiotic stresses during seedling emergence and crop establishment [10]. Hydro-primed seeds typically exhibit early, higher, and synchronized germination due to reduced lag time during imbibition, which otherwise takes longer [11]. Additionally, hydro-priming leads to the accumulation of germination-enhancing metabolites [12]. Studies have also indicated that priming seeds with a small amount of phosphate can stimulate early root growth, facilitating more effective uptake of available phosphorus (P) from the soil [13]. Rajpar *et al.,* [14] reported improved wheat yield through hydro-priming under non-saline conditions. Good establishment increases competitiveness against weeds, increases tolerance to abiotic stress especially dry spells and ultimately maximizes the yields [15]. Direct benefits due to seed priming includes, faster emergence, better and more uniform stands, more vigorous plants, better drought tolerance, earlier flowering and higher grain yield in many crops [16-18].

2. MATERIALS AND METHOD

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, Navsari during the rabi season of 2019-20. Navsari Agriculture University campus is geographically located at 20°57’ N latitude and 72°54’ E longitude, at an altitude of 10 meters above mean sea level. The climate of this region is characterized by fairly hot summers, moderately cold winters, and warm, humid monsoons with heavy rainfall. The winter season typically begins in the first week of November and continues until the middle of February. The soil of the experimental plot was alkaline in reaction, with a dark brown color and a clayey texture.

2.2 Treatments and Experimental Design

Total ten treatment combinations of two factors will be 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% $KMnO_4$ for 12 hrs and S5: Seed priming with 0.5% KH_2PO_4 for 12 hrs. Factor II- Fertilizer levels (F) F1: 75% RDF (112.5+45+00 N: P_2O_5: K_2O kg/ha) F2: 100% RDF (150+60+00 N: P_2O_5: K_2O 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 ×5.0 m each.

2.3 Experimental Procedures and Field Management

Three chemicals (KCl, $KMnO_4$ and KH_2PO_4) 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. Seed of *rabi* maize were soaked in a prepared solution of all the chemicals separately for 12 hours. After soaking, the seeds were dried in the shade until the seed coat became dry [19]. The total quantity of phosphorus and half the quantity of nitrogen were applied as a basal dose, with the remaining half dose of nitrogen given as a split application after three weeks of sowing. The nutrients were applied in the form of urea (46% N) and single superphosphate (16% P_2O_5) at a dose of 150+60+00 N: P_2O_5: K_2O kg/ha using the method of band placement with different doses according to the treatment.

The field was prepared with the help of a tractor drawn M.B. plough and planking and experiment was laid out as per the layout plan. Recommended seed rate of 20 kg/ha was used for sowing. Plot wise quantity of seed was weighted and applied different priming techniques as per treatment before sowing and sown manually at the depth of 4-5 cm by line sowing. Irrigations were given five times. First irrigation was given just after sowing for proper germination. For effective weed control, one hand weeding was carried out at 30 DAS with inter cultivation with mechanical weeder. In general, the crop stand was satisfactory and there was no ever incidence of pest and disease attack, so general application of Carbofuran 3G @15 kg/ha at 20 DAS was taken against maize stem borer.

2.4 Physio-Chemical Properties of the Soil

The soil of South Gujarat is locally known as ‘Deep black soil.’ The soil at Navsari campus falls under the great group Ustochrepts, a sub-group of Verti Ustochrepts, a sub-order of Orchrepts, and an order of Inceptisols with the Jalalpur series. The dry soil color is dark brown, and its texture is clayey. The soil in the experimental plot shows an alkaline reaction. These soils are derived from basalt, augite, granite gneiss, and limestone. When dry, they develop deep cracks and become extremely hard, while they are plastic and sticky when wet. The average solum thickness ranges from 2.5 to 3.0 meters, and the rooting depth extends up to 1.0 meter. Before commencing the experiment, a representative soil sample was collected from a depth of 0-15 cm, covering the entire experimental field. The samples were thoroughly mixed to create a composite sample, which was then analyzed for various physical and chemical properties. The average values are presented in Table 1.

2.5 Chemical Procedure

Representative samples from grain and straw were collected separately for estimating NPK content from each treatment across all three replications. The samples were washed with distilled water, sun-dried for a week, and then oven-dried at a temperature of 65°C ± 5°C for 24 hours. Subsequently, they were ground into powder using a mechanical grinder. The NPK content was determined using the methods outlined in Table 2. Nutrient uptake by maize grain and straw, as well as the total uptake, was calculated using the following formula:

Uptake of nutrient (kg/ha) = (Nutrient content in grain/straw (%) × grain/straw yield(kg/ha)) / 100

After harvesting the crop, soil samples were collected from a depth of 0-15 cm in all experimental units to assess changes in soil fertility status. These samples were analyzed for available nitrogen, P_2O_5, and K_2O using the procedures outlined in Table 2.

Table 1. Initial physio-chemical properties of the soil of experimental field

Sr. no. Particulars	Values (0-15 cm)	Methods adopted	References
I		Physical properties	
Sand (%)	13.65		
Silt (%)	19.51	International pipettemethod	
Clay (%)	66.84		
Textural class	Clay		Piper [28]
II		Chemical properties	
pH $_{1:2.5}$	7.79	pH meter	Jackson (1973)
EC 1:2.5 at 25° C (dS/m)	0.44	EC meter	Jackson (1973)
Organic carbon (%)	0.78	Walkley and Black Method	Jackson (1973)
Available N (kg/ha)	198.00	Alkaline $KMnO_4$ method	Subbiah and Asija, (1956)
Available P_2O_5 (kg/ha)	38.10	Olsen’s method	Olsen *et al*. [27]
Available K_2O (kg/ha)	324.23	Flame photometric method	Jackson (1973)

Table 2. The samples were analyzed for its available NPK as per the procedure

Parameters	Methods	References
	A. Soil chemical parameters	
Available N (kg/ha)	Alkaline permanganate method	Subbiah and Asija, (1956)
Available P_2O_5 (kg/ha)	Olsen’s method	Olsen *et al.* [27]
Available K_2O (kg/ha)	Flame photometric method	Jackson (1973)
	B. Plant analysis	
Nigtrogen (%)	Modified Kjeldahl’s Method	Jackson (1973)
	Wet digestion (Diacid)	Jackson (1973)
Phosphorus (%)	P:Vanedomolybdo yellow color method	
Potassium (%)	Flame photometric method	Jackson (1973)

3. RESULTS AND DISSCUTION

3.1 NPK Content in Grain

The data regarding NPK content in grain presented in Table 3 results revealed NPK content in grain of maize was not differed significantly due to different seed priming treatments while N content in grain was in significant due to fertilizer levels. The highest N content in grain was recorded with application of treatment F2 (1.99%). P and K content in grain of maize was not differed significantly due to different fertilizer levels. This might be due to increased availability of nitrogen and its uptake and storage in grain. Nitrogen, being the principal constituent of protein, increase the protein content which lead to N concentration and uptake in grain. Similar results were also reported by Srikanth *et al.* [20].

3.2 Nutrient Content in Straw

The data presented in Table 3 indicate that NPK content in maize straw did not differ significantly due to different seed priming treatments. However, nitrogen (N) content in straw showed significance based on fertilizer levels. The highest N content in straw was recorded with the application of treatment F2 (0.73%), while the lowest was observed with treatment F1 (0.63%). Phosphorus (P) and potassium (K) content in maize straw did not differ significantly across different fertilizer levels.

3.3 Nutrient Uptake by Grain

The data presented in Table 4 indicate that nutrient uptake by maize grain was significantly influenced by different seed priming and fertilizer level treatments. Significantly higher NPK uptake was with the seed priming of treatment S5 (90.75, 12.99 & 36.27 kg/ha respectively) and fertilizer level of treatment F2 (93.48, 12.95 and 36.56 kg/ha, respectively). N which was remained at par with treatment S3 (85.21 kg/ha) however P and K which at par with both treatment S3 (12.43 & 34.64 kg/ha respectively) and S4 (11.62 &33.82kg/ha respectively). Whereas, significantly lowest NPK uptake was recorded with S1 treatment (no priming) (73.14, 10.56 and 30.51 kg/ha respectively). Nutrient uptake by grains is higher due to higher yield and vigourous growth of plants. NPK uptake is higher because nitrogen (N) serves as a crucial structural component of the cell. N is essential for amino acids, proteins, nucleic acids, porphyrins, flavins, enzymes, and coenzymes. Phosphorus (P) contributes to the structure of cell membranes and mitochondria. It is also a vital component of nucleoproteins and organic molecules (such as ATP and ADP), which play key roles in cellular energy transfer reactions. Additionally, potassium (K) enhances assimilate translocation and promotes the rate of CO_2 assimilation and carbohydrate metabolism. These findings align with the research by Kushwaha *et al.* [21].

3.4 Nutrient Uptake by Straw

A data given in Table 4 revealed that significantly higher NPK uptake was with the seed priming treatment of S5 (59.96, 13.70, and 111.25 kg/ha respectively) and fertilizer level of treatment F2 (63.39, 13.70 and 112.89 kg/ha, respectively). N and K which was remained at par with treatment S3 (59.51 & 109.98 kg/ha respectively), S4 (57.78 & 108.41 kg/ha respectively) and S2 (56.00 & 105.90 kg/ha respectively) however P which at par with all treatments. Nutrient uptake by straw is higher due to higher yield and vigourous growth of plants. These results are also confirmed with Kushwaha *et al.* [21]. The enhanced uptake of nitrogen at higher doses resulted in an initial buildup of vigorous growth and a higher photosynthetic rate, leading to improved nutrient uptake throughout the crop growth period. Phosphorus uptake increased due to enhanced growth and yield attributes resulting from N application, as well as the direct impact of increased N uptake. Additionally, potassium uptake was influenced by the synergistic effect of N and K, along with the improved root foraging capacity due to increased NP (nitrogen-phosphorus) application. These findings align closely with the research conducted by Dharaiya *et al.* [22] in maize crops.

3.5 Total Nutrient Uptake

A data given in Table 4 and depicted in Fig. 1 revealed that total nutrient uptake by maize crop were significantly influenced by different seed priming and fertilizer level treatments. Significantly higher total NPK uptake was with the seed priming of treatment S5 (150.71, 26.69, and 147.52 kg/ha respectively) and fertilizer level treatment F2 (63.39, 13.70 & 112.89 kg/ha, respectively). N and K which was remained at par with treatment S3 (144.72 & 144.62 kg/ha, respectively) and S4 (140.73 & 142.23 kg/ha, respectively) while P which at par with treatment S3 (25.80), S4 (24.59) and S2 (23.59). Research by Kumar *et al.* [23] confirms that higher crop yield of grains and straw due to seed priming leads to increased total nutrient uptake. The availability of nutrients enhances root and early vegetative growth, resulting in increased photosynthetic activity. This is evident from the increased plant height, which facilitates the movement of metabolites from roots to shoots, especially in reproductive organs. The improved root growth and functional activity contribute to greater nutrient extraction from the soil environment into aerial plant parts. Nutrient uptake is closely tied to yield and nutrient concentration within the plant. Therefore, the enhanced uptake of nitrogen (N), phosphorus (P), and potassium (K) can be attributed to their concentration in grains and straw, as observed in similar findings reported by Dharaiya *et al.* [22] in maize crops.

3.6 NPK Status in Soil after Harvest

A perusal of data conferred in Table 5 divulged that NPK status in soil after harvest of maize crop were found K non-significant with different seed priming and fertilizer level treatments. N and P significantly higher available after harvest of crop with seed priming treatment

Table 3. Effect of various treatments on NPK content in grain and straw of maize

Treatment	Nutrient content in grain (%)			Nutrient content in straw (%)		
	N	P	K	N	P	K
Seed Priming (S)						
S1	1.80	0.260	0.752	0.64	0.147	1.278
S2	1.86	0.270	0.763	0.68	0.150	1.285
S3	1.89	0.277	0.772	0.70	0.157	1.292
S4	1.88	0.265	0.770	0.69	0.155	1.297
S5	1.92	0.277	0.775	0.70	0.160	1.302
SEm±	0.04	0.012	0.024	0.026	0.010	0.026
C.D. at 5%	NS	NS	NS	NS	NS	NS
Fertilizer Levels (F)						
F1	1.75	0.264	0.753	0.63	0.150	1.283
F2	1.99	0.276	0.779	0.73	0.157	1.298
SEm±	0.02	0.008	0.015	0.012	0.006	0.016
C.D. at 5%	0.07	NS	NS	0.035	NS	NS

Where, N- Nitrogen, P- Phosphorus, K- Potassium, S1- Control, S2- Water, S3- KCl, S4- $KMnO_4$, S5- KH_2PO_4, F1- 75% RDF, F2 -100% RDF, RDF: Recommended Dose of Fertilizer, NS- Non significant

Table 4. Effect of various treatments on NPK uptake by grain and straw and total nutrient uptake by maize

Treatment	Nutrient uptake by grain (kg/ha)			Nutrient uptake by straw (kg/ha)			Total nutrient uptake by maize (kg/ha)		
	N	P	K	N	P	K	N	P	K
Seed Priming (S)									
S1	73.14	10.56	30.51	51.68	11.86	103.14	124.82	22.42	133.65
S2	76.99	11.20	31.63	56.00	12.39	105.90	132.99	23.59	137.53
S3	85.21	12.43	34.64	59.51	13.37	109.98	144.72	25.80	144.62
S4	82.96	11.62	33.82	57.78	12.97	108.41	140.73	24.59	142.23
S5	90.75	12.99	36.27	59.96	13.70	111.25	150.71	26.69	147.52
SEm±	2.01	0.50	1.12	1.67	0.78	2.18	2.38	1.08	2.70
C.D. at 5%	5.96	1.49	3.33	4.96	2.32	6.46	7.06	3.20	8.01
Fertilizer Levels (F)									
F1	70.14	10.57	30.19	50.58	12.02	102.58	120.72	22.58	132.77
F2	93.48	12.95	36.56	63.39	13.70	112.89	156.87	26.65	149.45
SEm±	1.27	0.32	0.71	1.06	0.49	1.38	1.50	2.03	1.70
C.D. at 5%	3.77	0.94	2.11	3.14	1.47	4.09	4.47	0.68	5.07
S x F	S	NS	NS	NS	NS	NS	S	NS	

Where, N- Nitrogen, P- Phosphorus, K- Potassium, S1- Control, S2- Water, S3- KCl, S4- $KMnO_4$, S5- KH_2PO_4, F1- 75% RDF, F2 -100% RDF, RDF: Recommended Dose of Fertilizer, NS- Non significant, S- Significant

Table 5. Effect of various treatments on NPK status in soil after harvest of maize

Treatment	NPK status in soil after harvest of maize		
	Available Nitrogen (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Seed Priming (S)			
S1	194.50	31.67	363.33
S2	196.50	34.33	366.22
S3	206.67	38.50	372.25
S4	203.67	37.33	370.25
S5	207.00	39.67	375.17
SEm±	2.53	1.18	3.20
C.D. at 5%	7.53	3.51	NS
Fertilizer Levels (F)			
F1	190.73	31.87	366.88
F2	212.60	40.73	372.01
SEm±	1.60	0.75	2.02
C.D. at 5%	4.76	2.22	NS

Where, N- Nitrogen, P- Phosphorus, K- Potassium, S1- Control, S2- Water, S3- KCl, S4- $KMnO_4$, S5- KH_2PO_4, F1- 75% RDF, F2 -100% RDF, RDF: Recommended Dose of Fertilizer, NS- Non significant,

Table 6. Interaction effect of various treatments combinations on N uptake by grain and total N uptake by maize crop

Treatments	N uptake by grain (kg/ha)		Total N uptake by maize (kg/ha)	
Seed Priming (S)	Fertilizer Levels (F)			
	F1	F2	F1	F2
S1	67.9	78.4	115.86	133.77
S2	69.1	84.9	120.00	145.99
S3	71.6	98.8	123.57	165.87
S4	70.4	95.5	120.97	160.50
S5	71.7	109.9	123.21	178.21
SEm±	2.84		3.36	
C.D. at 5%	8.43		9.99	

Where, N- Nitrogen, S1- Control, S2- Water, S3- KCl, S4- $KMnO_4$, S5- KH_2PO_4, F1- 75% RDF, F2 - 100% RDF, RDF: Recommended Dose of Fertilizer

of S5 (207.0 & 39.67 kg/ha respectively) and treatment of fertilizer level F2 (212.60 and 40.73 kg/ha respectively) which was remained at par with treatment S3 (206.67 & 38.50 kg/ha respectively) and S4 (203.67 & 37.33 kg/ha respectively). Similar results were also observed by Srikanth *et al*. [20] and Dharaiya *et al*. [22] in maize crop.

3.7 Interaction Effect

The data presented in Table 6 indicated that interaction effect of seed priming and fertilizer levels was found significant for N uptake by grain (kg/ha) and total N uptake. N uptake by grain (109.9 kg/ha) and total N uptake (178.21 kg/ha) was significantly higher recorded with treatment combination S5F2 (KH_2PO_4 @ 0.5 % for 12 hrs with 100% RDF 150+60+00 N: P_2O_5: K_2O kg/ha) and significantly lowest N uptake by grain (67.9 kg/ha) and total N uptake (115.86 kg/ha) was recorded with treatment combination of S1F1 (no priming with 75% RDF 112.5+45+00 N: P_2O_5: K_2O kg/ha) while P and K uptake was found non-significant. The increased uptake of nitrogen at higher doses may have contributed to the initial vigor of plant growth and a high photosynthetic rate, resulting in improved nutrient uptake throughout the crop growth period. When a significant amount of nitrogen (N) is applied at or near anthesis, there is a greater possibility of its accumulation in sink rather than other vegetative parts. Total N uptake increasing due to root growth as well as vegetative growth of crops which enhanced higher extraction of nutrients from soil environment to aerial parts. Similar results were also observed by Ali *et al*. [24].

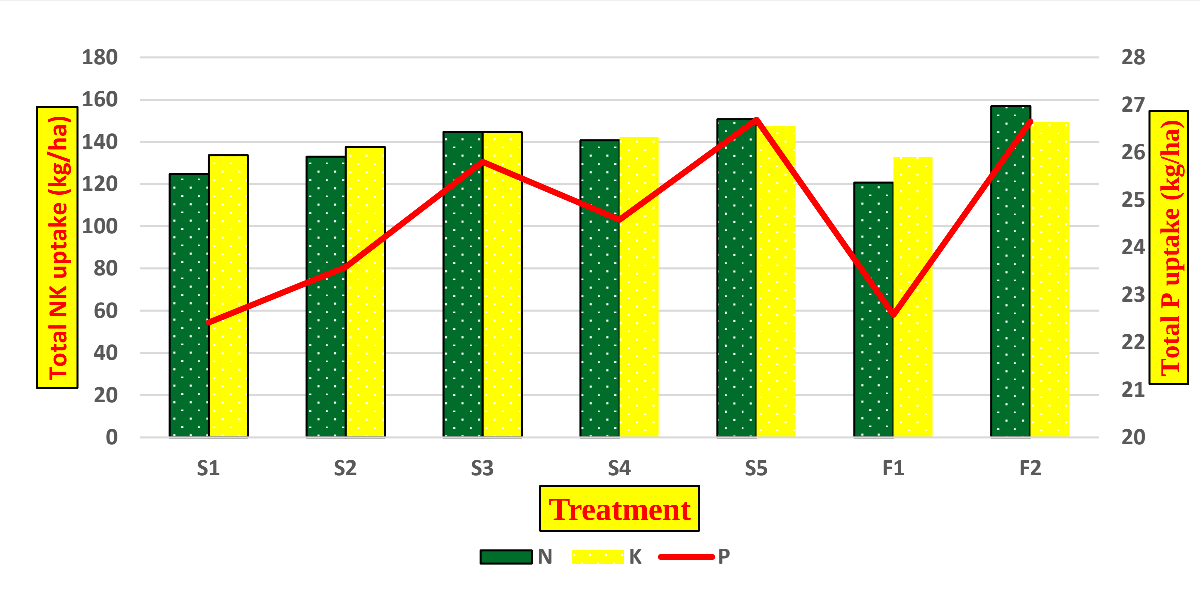

Fig. 1. Effect of various treatments on total NPK uptake of *rabi* maize

Maize yield largely depends on the optimum conditions of vigorous seedlings, which in turn depends on the adequate supply of essential plant nutrients. Nutrient seed priming technology can boost crop yields in soils of low fertility. Essentially, Nutrient seed priming is a technique, in which, seeds are soaked in nutrient solution containing essential micronutrients such as zinc, boron, molybdenum and macronutrients such as phosphorous [25]. This process increases seed nutrient contents along with the priming effect to improve seed quality for better crop yield. The benefits of nutrient seed priming are more pronounced during the early growth stages, and it is a widely accepted technology for improving yield [26-29]. Nutrient seed priming is widely used in parts of Asia: Bangladesh, Nepal, India and Pakistan, and studies showing that seed priming can increase maize yields by up to 70% [25]. However, establish a proper priming protocol, mineral concentration, and the priming duration should be considered to prevent possible nutrient toxicity that can hinder germination [30-32].

4. CONCLUSION

On the basis of one year experimentation, it can be concluded that *rabi* maize should be seed primed with KH_2PO_4 at 0.5 % for 12 hrs along with application of 100 % RDF (150+60+00 N: P_2O_5: K_2O kg/ha) and 5 t/ha bio-compost for obtaining higher N content in grain and straw, higher NPK uptake by grain and straw, total NPK uptake and more available of NPK after harvest of crop under south Gujrat 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.

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