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Effect of seed priming on fodder quantity and quality in fodder maize (*Zea mays* L.)

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Abstract

Maize (*Zea mays* L.) is one of the best fodder crops in the world due to its fast growing and high biomass production capacities. The growth and development of maize plants depend upon various factors like initial seedling vigour, conversion of photosynthates into biomass, duration of vegetative phase etc. To understand the impact of seed priming on initial seedling vigor, fodder yield and fodder quality like crude fiber content, we primed the seeds of fodder maize cv African tall and studied the field performance during Rabi, 2022-23. The seeds were primed with hydropriming (T₁), NaCl (T₂), osmopriming (T₃), hormonal priming with GA₃ (T₄) alongwith control. Our experimental results showed that the hormonal priming have shown a significant impact on improving the plant growth parameters like field emergence (91%), plant height at 30 DAS (58 cm), 60 DAS (218 cm) and 90 DAS (274 cm), crop stand establishment (72%), green fodder yield (56.84 kg/plot), dry biomass yield (30.61 kg/plot), No. of cobs/plot (149), seed yield per plot (8.74 kg/plot), crude fiber content (26.35%) and harvest index (50.96) over other treatments.

Keywords: Seed priming, GA₃, seed enhancement, fodder, maize

Introduction

Maize (*Zea mays* L.) is the most versatile crop with wider adaptability suitable for growing under varied agro-climatic zones. Maize consumption can be broadly divided in to three categories viz., food, fodder and industrial purposes. Maize crop as a fodder is an excellent option owing to its high palatable biomass potential and fast-growing nature. Maize fodder has a high nutritional value which aids in increasing the body weight and milk quality of livestock. Due to its high protein content, nutritional value and high palatability maize has a demand for potential export opportunities. African tall variety is a popular fodder maize variety used for making best quality silage in dairy industry. It is a short duration variety and yields high amounts of best quality green forage (30.9 tha⁻¹). African Tall Maize is a composite and possess a number of seed quality problems like fast seed deterioration, low germination, poor stand establishment, low seedling vigour etc.

Seed invigoration refers to those seed treatments which are either chemical, physical or physiological, those help in accelerating the germination, increasing the seedling vigour and improving the field stand. Seed priming is a pre-sowing partial hydration of seeds which is often used to improve crop performance. The different priming techniques are hydropriming, halopriming, osmopriming, hormonal priming etc. has proved to address the seed related issues in many crops. Keeping the above points in view the present investigation was carried out at Seed Research and Technology Centre during Rabi, 2022-23 to understand the effects of different priming techniques on fodder yield and quality in African tall variety of fodder maize.

Materials and Methods

Our study was aimed to evaluate the effect of seed invigoration on seed quality and fodder yield in maize (*Zea mays* L.). The laboratory and field experiments were conducted out during Rabi, 2022-23 at the Department of Seed Science and Technology, Seed Research and Technology Centre, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana. We obtained the pure freshly harvested seeds of fodder maize cv African tall from AICRP, Forage Crops, PJTSAU, Hyderabad.

The initial seed quality attributes are 98% germination, 35.73 g test weight and 12% seed moisture content. We have treated the seeds viz., Soaking in water for 12 hours (T₁), Soaking in NaCl @ 4 g/litre of water for 8 hours (T₂), Soaking in Polyethylene Glycol solution @ 10 g/litre of water for 8 hours (T₃), Soaking in GA₃ @ 0.2 g/litre of water for 8 hours (T₄) along with untreated control (T₅). After the soaking for specific period, seeds were removed from the solution and dried near to original seed moisture content with forced air at room temperature, and seeds were stored in cloth bags. The laboratory experiment was laid out in a factorial completely randomized design (RBD) with two factors i.e., months and treatments with 5 different seed priming treatments i.e., T₁, T₂, T₃, T₄ and T₅ in 4 replications. The treated seeds are tested for seed quality parameters viz., seed germination (%) (ISTA 2019), root length (cm), shoot length (cm), seedling dry weight (g), seedling vigour index I & II (Abdul Baki and Anderson, 1973) ^[1], field emergence (%) speed of germination (Maguire, 1962) ^[7] etc. The observations were taken on monthly basis for 5 months after seed treatments by following standard procedures.

To understand the effect of seed treatments on standing crop, treated seeds are sown in the field on 23rd of November 2023 in a randomized block design (RBD). The plot size was 5X4 sq. m and spacing was 60 x 20 cm. In the standing crop, we have taken observations viz., Field emergence (%), Plant height measured at 30, 60, 90 DAS, Number of days to first silking, Crop stand establishment, green fodder yield (kg/plot), Dry biomass yield (kg/plot), Number of cobs per plot, Seed yield per plot (kg), Crude fibre content (%) and Harvest index.

We statistically analyzed the data recorded in laboratory experiments by adopting Two Factorial Completely Randomized Design (CRD) techniques (Panse and Sukhatme, 1985) ^[9] while the field data was analyzed by following Randomized Block Design (RBD) by following (Gomez and Gomez, 1984) ^[6]. The significance of mean sum of squares for each parameter was tested against the corresponding error degrees of freedom using 'F' test (Fisher and Yates, 1963) ^[5]. Later, the least significant difference and critical difference at 5 per cent probability level were calculated wherever F test was significant and was used to compare treatment means.

Results and Discussion

The effect of seed treatments on field performance of fodder maize is as shown in the table no 1. Our observations on germination were validated with that of field emergence percentage as it gives true reflection of seed's ability to germinate under field conditions and to overcome various impediments. Field emergence gives accurate and reproducible results in predicting the planting value under field conditions. We recorded a highest field emergence (91%) with T₄ (seeds primed with GA₃ @ 0.2 g/litre of water for 8 hours) followed by 86% in case of T₃ i.e., osmo-priming with PEG while a lowest field emergence (77%) was observed in control (T₅). Our results are in conformity with the findings of Bassi (2005) ^[13] i.e., gibberellic acid treatment of wheat seeds improved germination and field emergence and also with that of Yogananda *et al.* (2004) ^[12] who reported that bitter gourd seeds primed with 100 ppm GA₃ for 24 hours gave better germination, field emergence, speed of emergence, seedling length and vigour index-I over the control.

Regarding the days to silking, our observations depicted that the seeds primed with phytohormone GA₃ came to flowering early by 2 days i.e., by 68 days as compared to hydropriming and control (70 days). It may be conferred that favourable climatic conditions during crop growth besides priming with phytohormone had a positive effect on early vegetative growth and flowering behaviour. Our findings were in line with that of Murungu *et al.* (2004)'s ^[8] findings in cotton and maize.

Our observations on field crop stand of maize seeds treated with various priming treatments depicted that T₄ showed the highest crop stand establishment (72%) followed by T₃ (69%). Incidentally, Tiwari *et al.* (2018) ^[11] also reported in pigeon pea that priming with GA₃ (100 ppm) for 12 hours has improved germination, speed of germination, seedling growth/stand establishment, and germination enzyme activity.

Similar results were also observed pertaining to green fodder yield per plot at 90DAS, a significantly higher green fodder yield was recorded in case of T₄ (56.84 kg/plot) followed by T₃ (50.01 kg/plot) and a lowest as observed in control (41.56 kg/plot). Our observations imply that the taller plants coupled with more number of leaves and higher dry matter production resulted in significantly higher green fodder yield in case of T₄. Our results are in conformity with that of wheat seeds soaked in GA₃ produced high fresh and dry matter yields (Radi *et al.* 2001) ^[10].

In case of our findings in case of dry biomass yield (kg/plot) also showed that T₄ increases dry matter yield (30.61 kg/plot) followed by T₃ (27.72 kg/plot) and our findings are in line with that of Radi *et al.* (2001) ^[10] in wheat and Akter *et al.* (2014) ^[2] in maize.

Our observations on the number of cobs per plot depicts the highest number of cobs per plot 149 (T₄) and 130 (T₃) which indicates that different seed invigoration treatments significantly influenced the number of cobs per plot. Similar results were also reported by Akter *et al.* (2014) ^[2] experiment with gibberellic acid and cytokinins to counteract the negative effects of drought on maize. However, it was also reported that the relative yield advantages for the hormones were mainly attributed to improving the cob and seed-bearing capacity of drought-stressed maize plants.

Grain yield is the final outcome of the crop growth and that a maximum crude fibre (%) was observed in case of T₄ (26.35%) as compared to that of other treatments cumulative effect of growth and yield attributing characters. We observed a significant effect of seed invigoration treatment on the maize grain yield with a highest grain yield was recorded in T₄ (8.74 kg/plot) followed by T₃ (6.29 kg/plot). Incidentally, similar findings were reported by Aldesuquy and Ibrahim (2001) ^[3] that the impact of seawater salinity stress on wheat productivity appears to be lessened when seeds are treated with growth bioregulators like GA₃.

Our data on crude fibre (%) of maize leaves depicts i.e., T₁ (19.25%), T₂ (17.82%) T₃ (20.63%), and T₅ (15.71%). Similar findings were observed by Ali *et al.* (2016) on the effects of different seed priming techniques on emergence, growth and yield of forage maize (*Zea mays* L.). The results showed that CaCl₂ priming produced seeds with the highest crude protein contents, whereas KNO₃ priming produced seeds with the highest crude fibre and ash contents, which were 77, 40, and 62% higher than control, respectively.

Table 1: Effect of Seed priming on field emergence, fodder quantity and quality in fodder maize

Treatments	Field Emergence (%)	Plant Height (cm)			Crop Stand (%)	Days to First Silking	Green Fodder Yield		Dry Biomass Yield		Crude Fiber (%)	No. of Cobs/Plot	Grain Yield	
		30 DAS	60 DAS	90 DAS			Kg/Plot	mT/ha	Kg/Plot	mT/ha			Kg/Plot	mT/ha
T ₁	81	47	187	263	64	68	48.20	36.40	20.90	15.80	19.30	114.00	5.20	3.90
T ₂	80	53	179	254	64	69	44.40	34.20	21.30	15.90	17.80	112.00	5.10	3.80
T ₃	86	56	200	270	69	69	50.00	34.40	27.70	19.10	20.60	130.00	6.30	4.30
T ₄	91	58	218	274	72	68	56.80	38.20	30.60	21.50	26.40	149.00	8.70	5.80
T ₅	77	46	169	252	63	70	41.60	31.90	20.50	15.50	15.70	110.00	4.10	3.00
Mean	83	52	190	263	66	69	48.20	35.00	24.20	17.50	19.90	123.00	5.90	4.20
SE(m)	0.68	3.36	8.25	4.97	0.69	0.74	1.12	0.90	0.56	0.72	0.34	2.80	0.30	0.18
CD	2.09	10.37	25.42	15.30	2.13	NS	3.44	2.77	1.72	2.21	1.03	8.64	0.92	2.20
CV %	1.63	12.98	8.65	3.77	2.07	2.16	4.64	5.13	4.63	8.15	3.36	4.54	10.12	8.78

Conclusions

Forage quality can be defined in various ways, but it is often poorly understood. Though important, forage quality receives far less consideration than it deserves. Producing good quality forage for a given situation requires knowing the factors that affect forage quality. Fodder crops have inherent seed quality problems. The germination (%) of fodder crops according to IMSC standards was low. So, there is a need to address the seed quality related problems in these crops. Based on the present study it is found that the hormonal priming with GA₃ has been proved to enhance the seed quality parameters and positively address the inherent seed related problems in fodder crops.

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