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Research article

EFFECT OF SEED PRIMING ON QUANTITATIVE TRAITS CORN

Mohammad Reza Vazirimehr[a*], Hamid Reza Ganjali[b], Khashayar Rigi[c], Abbas Keshtehgar[d]

[a]Young Researchers and Elite Club, Zahedan Branch, Islamic Azad University, Zahedan, Iran
[b]Department of Agriculture, Zahedan Branch, Islamic Azad University, Zahedan, Iran
[c] Young Researchers and Elite Club, Zahedan Branch, Islamic Azad University, Zahedan, Iran
[d] Young Researchers and Elite Club, Zahedan Branch, Islamic Azad University, Zahedan, Iran

ABSTRACT: Maize had its origin in a semi-arid area but it is not a reliable crop for growing under dry land conditions, with limited or erratic rainfall. Drought can be defined as the absence of adequate moisture necessary for a plant to grow normally and complete its life cycle. Drought occurs every year in many parts of the world, often with devastating effects on crop production. Seed priming is a successful method that has been proved to improve seed germination and emergence of seedlings. The experiment was conducted at the Agricultural Research Station, zahak (in Iran). The field experiment was laid out in randomized complete block design with split plot design with three replications. Seed priming with potassium nitrate solution in five levels (0, 0.5%, 1%, 1.5%, 2%) allocated to main plots and three levels of water stress Include: Control (no stress), Water stress at vegetative stage (5 leaflets) to enter the reproductive phase and Stress at reproductive stage until harvest. Analysis of variance showed that the effect of irrigation and priming on Plant height, stem diameter, Number of leaves, Biological yield Harvest index was significant.

Keywords: water stress, Plant height, Stem diameter, Number of leaves

INTRODUCTION

Maize (Zea mays L) is the third most important cereal after wheat and rice all over the world as well as in Pakistan. Maize is grown on an area of 9622000 ha with an annual average production and yield of 1665000 tonnes and 1730 kg ha-1, respectively [2]. Maize had its origin in a semi-arid area but it is not a reliable crop for growing under dry land conditions, with limited or erratic rainfall [4]. Breeders produce hybrid maize seeds by cross-pollinating inbred lines. Commercial hybrid production involves planting male and female inbred lines in separate rows in an isolated field where possibility of foreign pollen contamination is rare. For success in hybrid seed production, synchronization be-tween anthesis and silking of the parental inbred lines is essential. With regard to this point that maize is a protan-drous plant (anthesis is earlier than silking), it seems that synchronization can be achieved by delaying the sowing date of male lines in company with using of some pre-sowing seed invigoration treatments to improve germi-nation and emergence [34]. In northern Karnataka, maize is a major crop cultivated in irrigated areas of Navalgund and Nargund taluks of Dharwad district and as a rain fed crop in the neighboring Haveri district. In Haveri district, maize covers about 40 per cent of the agricultural land during kharif season. It is a high water demanding crop, and can produce high grain yields (4–6 Mg ha-1) when water and nutrients are not limiting. However, maize is sensitive to water stress [7, 36] and other environmental stresses around flowering period [35]. The environmental stresses resulting from drought, temperature, salinity, air pollution, heavy metals, pesticides and soil pH are major limiting factors in crop production [22, 25]. Among others, drought stress is a main abiotic stress that limits crop production [5]. Drought can be defined as the absence of adequate moisture necessary for a plant to grow normally and complete its life cycle [44]. Drought occurs every year in many parts of the world, often with devastating effects on crop production [27]. Increase in water use-efficiency for enhanced drought tolerance can be achieved by different strategies such as change of crops capable of producing acceptable yields under deficit irrigation or rainfed situations [14, 45] or by strategies involving agronomic practices like different seed-priming methods [20, 21]. Particularly at on-farm level. Seed priming is a successful method that has been proved to improve seed germination and emergence of seedlings. It is a controlled hydration treatment at low water potential that allows pregerminative metabolism to proceed, but prevents radicle emergence [5].

Seed priming is a technology that has been shown to positively influence germination and establishment of crop [20, 28, 31, 32, 33, 37, 39]. Priming is a non-expensive and value added practice that greatly improve yield. This might be due to some biochemical and physiological changes brought about by seed soaking [24]. The improved germination of primed seeds may therefore, be attributed to counteraction of free radicals and re-synthesis of membrane bound enzymes as in unprimed seeds [41]. Direct benefits in many crops included: faster emergence, better and more uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering and higher grain yield from priming [21]. Harries [20] proposed this low cost, low risk intervention termed on-farm seed priming that would be appropriate for all farmers, irrespective of their socio-economic status. Seed priming is not a new technology and has been a recommended practice in many crops in India. But farmers do not appreciate the wide range of benefits from this low-cost, low-risk practice unless they are given the opportunity to experiment for themselves. If, this technology is refined and developed using participatory approaches, it will have a positive impact on the livelihood of resource poor farmers. Success of seed priming is influenced by the duration of priming until the optimum hours. For every crop species, there is a safe limit, the maximum length of time, if ex-ceeded, could lead to seed damage [21]. The beneficial effects of priming have also been demonstrated for many field crops such as wheat, sugar beet, maize, soybean and sunflower [23, 28]. Priming treatment consists of soaking seeds in an osmotic of low water potential to control the amount of water supply to the seed. At the cellular level, few processes have been described to act during priming some of these being: activation of cell cycle [9] and mobilization of storage proteins [17].The priming-induced increase in the rate of seed germination has been associated with the initiation of germination-related processes [40], repair processes [11] and increase in various free radical scavenging enzymes, such as superoxide dismutase, catalase and peroxidase have also been demonstrated [17]. In semi-arid tropic of Khyber Pukhtunkhwa, maize production is widely limited by poor stand establishment and nutrient deficiencies. Rapid and uniform field emergence is also an essential prerequisite to reach the yield potential, quality, and ultimately profit in crops. It is reported that P-deficiency had a detrimental effect on morphogenesis and physiological mechanism in maize, and P-deficiency symptoms and biomass have been known as indicative traits of maize in response to low-P stress [13, 18, 26].

MATERIAL AND METHODS

The experiment was conducted at the Agricultural Re-search Station, zahak (in Iran) which is situated between 54° North latitude and 41° East longitude and at an altitude of 483m above Mean Sea Level. The crop was sown on well prepared seed beds on August 5, 2012 by using the seed rate of 25 kg ha-1. The plot contained four lines in each plot having inter-row and intra-plant spacing of 75 cm and 25 cm respectively. The soil of the experimental site belonging to the order Alfisol is clay loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analysed for physical and chemical characteristics. The field experiment was laid out in randomized complete block design with split plot design with three replications. Seed priming with potassium nitrate solution in five levels (0, 0.5%, 1%, 1.5%, 2%) allocated to main plots and three levels of water stress Include: Control (no stress), Water stress at vegetative stage (5 leaflets) to enter the reproductive phase and Stress at reproductive stage until harvest. was allocated to sub plots. The control treatment was dry seed (nonprime). An inorganic fertilizer dose of N (200 kg ha-1), P (150 kg ha-1), and K (125 kg ha-1) was applied in all treatments. Whole phosphorous, potassium and one third nitrogen was applied at the time of sowing; the other one third nitrogen was applied at first irrigation while remaining one third nitrogen was applied at second irrigation. Plots were irrigated when needed. Sources of fertilizers were DAP 9 bags, Urea 3 bags and SOP 4 bags. Thereafter seeds were removed, given three surface washings and re-dried with forced air near to its original weight. Untreated seeds were used as control treatment. The remaining half of nitrogen was top dressed on 30th day after sowing (DAS). A week after emergence, seedlings were thinned to maintain two plants per hill. Final thinning was done two weeks after emergence to maintain only one healthy seedling per hill. To check weed growth, intercultivation was carried out two times at 15 and 30 DAS using blade hoe and hand weeding was done at 25 and 45 DAS. A week after emergence, seedlings were thinned to maintain two plants per hill. Final thinning was done two weeks after emergence to maintain only one healthy seed-ling per hill. To check weed growth, inter cultivation was carried out two times at 15 and 30 DAS using blade hoe and hand weeding was done at 25 and 45 DAS. The cobs and ears were harvested at physiological maturity stage from the net plot and were sun dried. After drying, threshing was done to separate the kernels and grains and was dried to 10 per cent moisture level before storing. Ten plants per plot were selected randomly in the net plot area. The height of the plant was measured from base of the plant (first nodal mark) to base of fully opened leaf until tassel emergence, after which plant height was measured from base of plant to the tip of the tassel and expressed in cm. Number of kernel rows per cob was counted and recorded; their average number from ten cobs was taken as the number of kernel rows per cob. Harvest index is defined as the ratio of economic yield to the total biological yield [11]. Data collected were subjected to statistical analysis by using a computer program MSTATC [16].

Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means [43].

RESULTS AND DISCUSSION

Plant height

Analysis of variance showed that the effect of irrigation on plant height was significant at the one percent level (Table 1). So that maximum plant height (76.143 cm) was observed in control and irrigation treatments compared to its height in the heading to maturity (37.140 cm) was higher (Table 2). It seems that drought stress reduced cell development by inflammatory cells leads to a reduction in the height of maize. The drought conditions due to the reduction in cytokine transport from root to shoot and leaf absezic acid increased the flexibility of the cell wall was de-creased, the decreased growth [29]. Plant height was affected by potassium nitrate, so that the maximum plant height (44.149 cm) was observed at a concentration of one percent (Table 2). A corn seed priming in plant height in-creases were relative to the control so that the differences were significant at the one percent level [11]. Research on seed priming significantly increased the number of nodes on the main stem of control and result in an increase in height compared to the control treatment was primed [1].

Stem diameter

Analysis of variance showed that there was no significant effect of irrigation on stem diameter (Table 2). Productivity with the highest stem diameter (46.24 mm) was observed in control and irrigation treatments compared with its diameter from heading to maturity (40.23 mm) was significantly higher3). A lack of moisture and drought in the three stages of corn growth and its effect on the performance of the studied And observed that drought stress had no significant effect on maize stem diameter [10]. Stem diameter were not influenced by potassium nitrate, so that the maximum diameter (11.24 mm) was observed at a concentration of one percent (Table 2).

Number of leaves in plant

Analysis of variance showed that the effect of irrigation on leaf number was significant at the one percent level (Table 2). So that the maximum number of leaves in plant (11.24) was observed in the control treatment compared with those treated with irrigation from heading to maturity (10.26) was higher (Table 3). A lack of moisture and drought in the three stages of corn growth and its effect on performance is studied and observed the incidence of drought reduces by 15 percent the number of leaves per plant than the control treatment (no stress) were [10]. The study revealed that less watering in the early vegetative growth, number of leaves per plant corn reduces [36]. Number of leaves per plant was not affected by potassium nitrate, so that the maximum number of leaves per plant (10.84) was observed at a concentration of one percent (Table 2). Priming the shortening of time from sowing seed emergence and preservation of biotic and abiotic factors in the critical establishment and the number of leaves in primed seeds compared to control (non-primed) were higher [30].

Number of kernel per row

Analysis of variance showed that the effect of irrigation on grain number in row% probability level was significant (Table 1). So that the maximum Number of grains per row (47.89) was observed in the control treatment compared with those treated with irrigation from heading to maturity (46.52) was higher (Table 2). It appears that the incidence of stress due to increased production due to shortage of sterile pollen grains per ear row number Parvadeh decrease corresponded with the results of other investigators (Classen and Shaw, 1970). Number of grains per rows was affected by potassium nitrate, to so that the maximum Number of grains per row (51.01) was observed at a concentration of one percent (Table 2). The study found that priming increased the number of grains per row, compared to control (non-primed) were [34].

Germination percent

The results of the analysis of variance showed that the effect of drought on Germination percent was statistically significant at the one percent level (Table 2). Be inferred from the table that the highest mean Germination percent in non-stress conditions (72.33 percent), respectively (Table 2). It seems that the reduction in germination, reduce water contact with crop and lower hydraulic conductivity of the water is around the seeds. Increased drought reduces water availability and adverse effect on the Germination percent will be [37]. Drought and restricted water uptake by seed grain storage and protein production through its effect on the transfer of the embryo germination is probably the major cause [22]. The results of the analysis of variance showed that the effect of priming on Germination percent was statistically significant at the one percent level (Table 2). So that the comparison is taken out one of the highest concentrations of nitrate in the Germination percent (92.66 percent), respectively (Table 3). The maximum final ger-mination in seeds of maize research that had been in the water for 36 hours was observed [44]. Osmopriming corn seed using polyethylene glycol and potassium nitrate were accelerated germination at low temperature [5].

Biological yield

The results of the analysis of variance showed that the effect of stress on Biological yield statistically significant at the one percent level (Table 2). So that the comparison is taken out of the highest Biological yield in stress conditions (26.94 ton/ha) was observed (Table 2).

It seems that the reduction in total dry matter production in plants under drought stress conditions and unfit to continue to expand the control plants had lower leaf surface reduces the efficiency of light utilization and dry matter were produced. The effects of drought, biological yield were significantly lower in maize [14].

Table 1. Analysis of variance for maize (SC704) characteristic as affected by reduce watering and Potassium nitrate treatments

		MS							
S.O.V	**df**	**Germination percent**	**Tassel weight**	**Biological yield**	**Harvest index**	**Plant height (cm)**	**Stem diameter (mm)**	**No. of leaf (Plant $^{-1}$)**	**No. of Kernel (row-^{1})**
Replication	2	8.86^{ns}	0.13^{ns}	20.92^{ns}	0.34^{ns}	8.69^{ns}	77.06^{ns}	1.89^{ns}	0.67^{ns}
watering Reduce (A)	2	84.06**	1.95**	178.19**	1.11**	43.28**	5.06^{ns}	2.82**	7.00**
Error (a)	4	0.03	0.01	0.58	0.05	0.76	44.63	0.18	0.01
Potassium nitrate (B)	4	8659.42**	7.74**	477.09**	16.13**	305.09**	11628.25^{ns}	0.05 ^{ns}	84.66**
A*B	8	2.20**	0.76**	25.06**	0.05^{ns}	2.45**	105.4 ^{ns}	0.55 ^{ns}	0.41**
Error (b)	24	0.14	0.03	1.34	0.05	0.69	6.87	0.46	0.02
C.V (%)	-	0.54	6.14	4.93	2.75	0.58	11.61	6.35	0.36

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively. C.V: Coefficient of Variation

Table 2. Means comparison of maize (SC704) characteristic as affected by reduce watering and Potassium nitrate treatments

Treatments	**Germination percent**	**Tassel weight**	**Biological yield**	**Harvest index**	**Plant height (cm)**	**Stem diameter (mm)**	**No. of leaf (Plant -1)**	**No. of Kernel (row-1)**
watering Reduce								
Control	72.33a	3.23a	26.94a	8.98a	143.76a	24.46a	11.04a	47.89
SI	69.86b	2.81b	23.38b	8.70b	142.21b	23.53a	10.98a	47.29
SE	67.60c	2.51c	20.05c	8.44c	140.37c	23.40a	10.26b	46.52
Potassium nitrate								
Control	83.77c	2.56c	21.87c	8.58c	142.75c	23.88a	10.77a	47.55c
o.5%	88.22b	3.04b	28.46b	9.50b	145.08b	24.00a	10.80a	48.86b
1%	92.66a	4.36a	33.23a	10.44a	149.44a	24.11a	10.84a	51.01a
1.5%	68.00d	2.31d	17.80d	8.07d	139.18d	23.55a	10.73a	45.81d
2%	17.00e	1.99e	15.91e	6.94e	134.11e	23.44a	10.64a	42.92e

Any two means not sharing a common letter differ significantly from each other at 5% probability
SI: Stop of irrigation from sowing to heading , SE: Stop of irrigation from ear emergence to full maturity

The results of the analysis of variance showed that the priming effect on the Biological yield of the difference was significant at the one percent level (Table 2). So that the comparison is taken out one of the highest concentrations of nitrate in Biological yield (33.23 tons per acre), respectively (Table 2). In a study on the effects on sunflower osmopriming hydro priming It was found that increasing the Biological yield of sunflower in comparison to the control (non-primed) were [28]. The report found that priming treatments increased the biologi-cal yield of 7% compared to the control [13].

Biological yield tassels weight

Analysis of variance showed that the effect of irrigation on tassels weight was significant at the one percent level (Table 2). So that the highest tassels weight (3.23 g) was observed in control and irrigation treatments compared to its weight on the heading to maturity (2.51 g) was higher (Table 2). The research found that increasing water deficit leaf water potential in maize became increasingly negative and significant decreases in the weight of the tassels [18].

Drought stress during flowering in maize tassels were reduced 25% by weight [6]. Tassels weight of potassium nitrate was affected, so that the highest tassels weight (4.36 mg) was observed at a concentration of one percent (Table 2). The investigation determined that the corn tassels priming cause weight gain, compared to control (non-primed) were [26]. Priming the shortening of time from sowing seed emergence and preservation of biotic and abiotic factors and the weight of the critical tassels seeds primed in comparison with control (non-primed) were higher [30].

Harvest index

The results of the analysis of variance showed that the effect of stress on Harvest index was statistically significant at the one percent level (Table 2). So that the comparison is taken out of the highest Harvest index under stress (8.98%) respectively (Table 2). A team of researchers from severe drought stress on yield losses greater than the total dry weight and higher sensitivity compared to vegetative and reproductive growth factor drought reduced harvest index did [35]. The results of the analysis of variance showed that the priming effect on harvest index was statistically signify significant at the one percent level (Table 2). So that a comparison can be inferred from Table Harvest index the highest concentration of potassium nitrate (10.44 %), respectively (Table 2). It seems that seed priming to improve dry matter partitioning to grain and increased harvest index and seed yield these results corresponded with the findings of other researchers [1].

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