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Enhancing Sorghum Green Fodder Production Potential through Use of Various Sources and Levels of Osmopriming

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Abstract:

Poor seed performance and unsynchronized germination are the main factors which reduce fodder crops yields in tropics. In this regard a field experiment was conducted to evaluate the response of sorghum green fodder yield to various sources and levels of osmopriming. The experiment was laid down in randomize complete block design with four replications. In this research eight priming sources i.e. NaCl, $CaCl_2$, KCl, KNO_3, NH_4Cl, Na_2SO_4, PEG and Manitol along with seed soaking in water and control were tested on fodder sorghum performance. Sorghum seed was primed for 24 hour. The data was recorded on various phonological parameters and green fodder yield. Osmopriming sources and levels significantly affected sorghum phenology and green fodder production. PEG 8000, NaCl, $CaCl_2$ showed best results in term of sorghum phenology and green fodder yield. Similarly NaCl and PEG 800 were also better than other chemical sources. KNO_3 showed very poor performance among all chemicals. The lower levels of most chemicals performed better than

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higher levels. It was concluded that soaking seed with osmopriming agents improve phenology and green fodder production.

Key words: sorghum green fodder production, levels of osmopriming, phenology

1. Introduction

Sorghum (*Sorghum biclor L.*) is an important food and forage crop of arid and semi arid region of the world. It ranks fifth among cereals after wheat, maize rice and barley. Sorghum contains 6.84 % protein, 1.5 % fats, 6.75 % ash, and 53.1 % nitrogen free extract [1]

Seed priming comprises the soaking of seed in water and drying back to the storage moisture until use. The soaking induces a range of biochemical changes in the seed that are required to start the germination process such as breaking of dormancy, hydrolysis or metabolization of inhibitors, imbibition and enzyme activation. Some or all of these processes that precede the germination are triggered by priming and persist following the re-desiccation of the seeds. Thus upon seeding, primed seed can rapidly imbibe and revive the seed metabolism, resulting in a higher germination rate and a reduction in the inherent physiological heterogeneity in germination. The resulting improved stand established can reportedly increase drought tolerance, reduce pest damage, increase crop yield [2].

Crop production is affected by a low chemical availability of P and Zn. Especially during the early growth stages, a lack of P and Zn retards seedling growth, rendering the young plantlets particularly sensitive to the frequently encountered dry spells [3]. A rapid establishment of healthy seedlings and a sufficient supply with P and Zn are prerogative to reduce the risk of crop failure. Nutrient priming has been

proposed as a novel technique that combines the positive effects of seed priming with an improved nutrient supply [4]. In nutrient priming, seeds are pretreated (primed) in solutions containing the limiting nutrients instead of being soaked simply in water.

Keeping in view the positive effects of this low cost alternative approach, the present experiment was therefore conducted to evaluate the effect of seed priming in nutrient solutions on emergence and yield of maize.

2. Materials and Methods

Site description

The experiment was conducted at New Developmental Farm KPK Agricultural University Peshawar during summer 2007. The experimental farm is located at 34.01^{o} N latitude, 71.35^{o} E longitude at an altitude of 350 m above sea level in Peshawar valley. Peshawar is located about 1600 km north of the Indian Ocean and has continental type of climate. The research farm is irrigated by Warsak canal from river Kabul. Soil is clay, low in organic matter (0.87%), extractable P (5.6 mg P kg-1), exchangeable potassium (121 mg K kg-1), alkaline (pH 8.2) and is calcareous in nature. Mean annual rainfall in the region varies from 300 to 500 mm, of which 70% occurs in summer.

Experimental description

Eight osmopriming sources each with two levels were used in experiment along with water soaked and control were tested in a field experiment in Randomize Complete Block Design with four replications. The treatment used were T1=Control, T2= Hydro priming, T3= NaCl 150 mM, T4= NaCl 300 mM, T5=$CaCl_2$ 150mM T6=$CaCl_2$ 300mM, T7=KCl 150Mm, T8=KCl 300mM, T10=Na_2SO_4 150m T10=Na_2SO_4 M300mM, T11= NH_4Cl 150mM , T11= NH_4Cl , T13=KNO_3 150Mm T13=KNO_3

150Mm, T15= Manitol 2%, T15= Manitol 4 %, T17=PEG 100g lit^{-1} , T18= PEG 100g lit^{-1} The seeds were primed for 24 hours before sowing. Dry seeds of sorghum were used as a control treatment. Basal dose of NP at the rate of 100-50 kg ha^{-1} was applied to each plot. Urea and Single Super Phosphate was used as sources of N and P, respectively. Plot size was 3x4 m with seed rate of 25 kg ha^{-1}. Approximately 30 g of primed and untreated seed was sown in each plot of 12 m having 6 rows of 4 m length and 50 cm apart. All other agronomic practices including hoeing, weeding and irrigation were uniformly applied to each plot treatment during the experiment.

The data on number of stalk m^{-2} was recorded by counting number of plants in one-meter row length at three different places in each plot plants was counted and average was obtained .Numbers of leaves were counted on five representative tillers randomly selected in two central rows in each treatment and average was calculated. Five plants were harvested from two central rows of each treatment at bloom stage and were weighted with electronic balance in the laboratory. The plants harvested for shoot fresh weight was dried in the sun and was again weight after complete drying. For biological yield two central rows was harvested air-dried, weighed and was converted in to ton ha^{-1}.

Statistical analysis

Data collected during the course of the experiment was analyzed according to Randomize Complete Block Design and upon obtaining significant F. value; least significant difference (LSD) test was employed [5].

3. Results and discussions

Stalk m^{-2}

Stalk m^{-2} was significantly affected by osmopriming sources and levels of osmopriming concentration while insignificantly by chemical sources (CS) Vs levels (Table 1). The interaction between CS x C, and HP Vs CS was not significant. Mean values showed that maximum stalk m^{-2} (46.6) was recorded for $CaCl_2$ 150mM followed by Na_2SO_4 150mM (42.1) stalk m^{-2} while minimum stalk m^{-2} (28.9) was recorded for KNO_3.

Control produced more stalk m^{-2} (39.8) compared with hydro priming (36.4). Hydropriming produced more stalk m^{-2} (38.5) than chemical sources (36.1).Lower concentration of all chemical sources produced stalk m^{-2} than higher concentration except KCL, PEG 8000 and Manitol. Same results are obtained by Hubungi [6] who reported that more $stalks^{-2}$ in lower levels of osmopriming agents was recorded due to of high germination and good crop establishment.

Number of leaves $stalk^{-1}$

Statistical analysis of the data revealed that number of leaves $stalk^{-1}$ was significantly affected by osmopriming sources (OS) while none significantly affected by levels of osmopriming concentration (table 1). The interaction between control (C) Vs chemical sources (CS) was not significant while significant for Hydropriming (HP) Vs CS. Mean values showed that maximum number of leaves $stalk^{-1}$ (19) was recorded for $CaCl_2$ 150mM followed by hydropriming (18.9 leaves Stock-1) while minimum number of leaves $stalk^{-1}$ (14.5) was recorded for KNO_3 150 mM. Control produced more number of leaves $stalk^{-1}$ (17.4) compared with hydropriming (17.1). Hydropriming produced more number of leaves per stocks (18.9) than chemical sources (16.9). Lower concentration of KCL $CaCl_2$ and NaCl2 and NH_4Cl produced more number of leaves $stalk^{-1}$ than higher concentration while high concentration of Manitol, PEG 8000, Na_2SO_4 and KNO_3 produced more number of leaves per stock

than lower concentration. These results are in agreement with the workm of Ruiz and his colleagues [7].

Shoot fresh weight (g)

Shoot fresh weight was significantly affected by (OS) and osmopriming levels (OL) (Table 1). The interaction between control (C) Vs hydropriming (HP) was not significant and chemical sources (CS) Vs HP was significant. Mean values showed that maximum shoot fresh weight (178.75 g) was recorded for $CaCl_2$ 150mM followed by NaCl 150mM (177 g) while minimum shoot fresh weight (147 g) was recorded for KNO_3 150 mM. Control produced less shoot fresh weight (159 g) than hydropriming (163.6 g). Hydropriming produced less shoot fresh weight (156.3 g) than chemical sources (164.5g). Lower concentration of KNO_3 $CaCl_2$, NaCl and NH_4Cl produced more shoot fresh weight than higher concentration while lower levels of PEG 8000, Manitol and Na_2SO_4 produced less shoot fresh weight than higher concentration. This decrease in shoot fresh weight is due to decrease in leaf area and thus less photosynthesis [3].

Shoot dry weight (g)

Data regarding shoot dry weight is presented in table 1. Statistical analysis of the data revealed that shoot dry weight was significantly affected by osmopriming sources (OS) and osmopriming levels (OL),. The interaction between control (C) Vs hydropriming (HP), and chemical sources (CS) Vs HP was none significant. Mean values showed that maximum shoot dry weight (33.40 g) was recorded for $CaCl_2$ 150mM followed by NaCl 150mM (31.85 g) while minimum shoot dry weight (21.90 g) was recorded for KNO_3 300 mM. Control produced and hydropriming produced same shoot dry weight (27.7 g). Hydropriming produced less shoot dry weight (27.1 g) than chemical sources (27.7g). Lower concentration of KNO_3 $CaCl_2$,

NaCl and NH_4Cl produced more shoot dry weight than higher concentration while lower levels of PEG 8000 Manitol and Na_2SO_4 produced less shoot dry weight than higher concentration. The decrease in shoot dry weight might be due the fact of poor leaf area and thus low photosynthesis [3].

Fodder yield (kg ha^{-1})

Fodder yield is one of the most important parameter. The ultimate aim of a fodder is Fodder yield. Statistical analysis of the data revealed that Fodder yield was significantly affected by osmopriming sources (OS), osmopriming levels (OL), control (C) Vs hydropriming (HP), chemical sources (CS) and interaction between CS x L, and HP Vs CS (Table 18). Mean values showed that maximum Fodder yield (14.7 ton ha^{-1}) was recorded for NaCl followed by $CaCl_2$ (11.2 ton ha^{-1}) while minimum Fodder yield (2.8 ton ha^{-1}) was recorded for KNO_3. Hydropriming produced more Fodder yield (9.2 ton ha^{-1}) compared with chemical sources (7.9 ton ha^{-1}). Control produced higher Fodder yield (9 ton ha^{-1}) than hydropriming (8.1 ton ha^{-1}).

Lower concentration of NaCl, $CaCl_2$, Na_2SO_4 and Manitol Produced more Fodder yield than higher concentration while higher concentration of NH_4Cl, KNO_3 and PEG 8000 resulted in higher yield than lower concentration. The difference in Fodder yield is due to the fact that primed seed germinates more rapidly and uniformly than unprimed seeds [4]. NaCl produced higher Fodder yield the changes in growth and physiological responses induced by NaCl pretreatment are maintained throughout life cycle [7].

Conclusion

It is concluded from our experiment that under the semi arid condition of Peshawar valley seed priming should be carried out

for higher green fodder yield in sorghum. As green fodder is one of the most importance factor in animal feed so we recommend seed priming with osmopriming chemicals in low concentration (<150 mMol lit^{-1}).

Table: 01. Stalk m^{-2} leaves stalk, shoot fresh weight, shoot dry weight and Fodder yield sorghum as affected by different sources and levels of osmopriming.

T	Priming Source	Conc.	Stalk m^{-2}	Leaves $plant^{-1}$	Fresh Weight (g)	Dry Weight (g)	Fodder yield (ton ha^{-1})
1	Control		39.8 abcd	17.4 cdefg	159.0efg	27.70efg	9.0 d
2	HP		38.5g	18.9ab	156.2fgh	27.13fgh	9.2d
3	NaCl	150mM	39.1abcd	17.7abcd	177.00ab	31.85ab	19.3 a
4	NaCl	300mM	34.6abcd	17.2cdefg	163.75de	27.25efg	10.1cd
5	$CaCl_2$	150mM	46.6bcdef	19.0a	178.76a	33.40a	16.5 b
6	$CaCl_2$	300mM	35.2a	16.4defgh	158.7efg	27.75ef	5.9 c
7	KCl	150mM	32.1bcde	18.6abc	175.5ab	30.95bc	10.5 c
8	KCl	300mM	32.3cdef	17.7abcd	171.25bc	30.35bcd	6.1 c
9	Na_2SO_4	150mM	42.1ab	16.2efgh	158.75ef	25.85hi	9.3 d
10	Na_2SO_4	300mM	26.8f	17.5bcde	169.00bc	29.35cde	5.6 e
11	NH_4Cl	150mM	36.9bcde	16.0fgh	158.50ef	25.80hi	4.0 f
12	NH4Cl	300mM	34.6bcdef	15.9ghi	151.75gh	24.68ij	9.0 d
13	KNO_3	150mM	30.3def	14.5i	147.00i	22.85jk	2.6 g
14	KNO_3	300mM	28.9ef	15.3hi	149.75hi	21.90k	3.0 fg
15	Manitol	2 %	37.9abcd	16.8defg	156.25fg	25.88ghi	9.1 d
16	Manitol	4 %	39.1abcd	17.3cdefg	166.75cd	28.15def	4.1 f
17	PEG	100g L^{-1}	40.2abc	16.9dfeg	174.25ab	28.65def	5.6 c
18	PEG	200g L^{-1}	40.9ab	17.1defg	175.50ab	28.93def	5.7 e
	LSD P<0.05)		1.4	1.2	8.3	1.4	1.1

Mean followed by same letter(s) with in the same category are not different statistically using least significant difference (LSD) test at 5% level of probability.

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