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Effects of Different Levels of Soil Moisture on Seed Germination and Seedling Growth of Some Cultivars of *Penisetum americanum*

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Abstract: Effects of different levels of soil moisture on seed germination and seedling growth of two cultivars of *Pennisetum americanum* i.e. Tiftlate synthate and IC-8206 were investigated. In cv. Tifttlate synathe, the seed germination was much faster in treatments B and C as compared to that in treatments A and D. Similarly, in cv. IC-8206 the rate of seed germination in treatments B was much faster as compared to that in treatments A, C and D. The seedling growth was minimum in drought condition as well as in water logged condition.

Key words: Soil moisture, germination, growth measurements, *Pennisetum americanum*

INTRODUCTION

Soil drought and water logging are the major threats to crop productivity in arid and semi -arid regions of the world and cause many economic problems. Such soils may be used by growing economic plants capable of with standing adverse soil conditions. Autecological studies are pre-requisite for exploring such possibilities[1].

In Pakistan few studies have been directed towards this objective[2-6]. Out side the country a lot of work has been carried out regarding the effects of different levels of soil moisture on crops. Jackson and Drew[7] studied the effects of flooding on growth and metabolism of herbaceous plants. Chaudhary *et al.*[8] have investigated the response of rapeseed to irrigation and nitrogen levels under sandy clay loam soils. Similarly several other workers have made extensive studies regarding the response of different crops at varying soil moisture levels[9-16].

The different cultivars belonging to genus *Pennisetum americanum* L are most valuable fodder crops and are sown at large scale in Pakistan. Despite their considerable importance for food, feed and fodder, very little work has been done on these cultivars with particular reference to their ability to resist drought and water logging. The present study was carried out to examine the germination responses of two cultivars of *Pennisetum americanum* L. i.e., Tiftlate synthate and IC-8206, to different levels of soil moisture.

MATERIALS AND METHODS

On 17th April, 2001, a sandy clay loam soil used in these studies was obtained from top 15 cm of a cultivated field in Botanical Garden, B.Z.University, Multan.This soil was crushed and pieces of roots and leaves, if any were removed. The field capacity of the soil was determined prior to being placed in Petridishes to achieve the desired moisture levels. Seed germination studies on cultivars i.e. Tiftlate synthate and IC-8206 were carried out in the laboratory in sterilized Petridishes of 40-cm diameter. A sandy clay loam soil having field capacity (F.C.) of 30% was used in these studies. There were four treatments: A, B, C and D. Each treatment had six replicates. The healthy seeds of each of the two cultivars i.e. Tiftlate Synthate and IC-8206 were sown in each petridish containing the soil. Weight of each Petridish containing soil was noted. The dishes were weighed every day and loss in weight, if any, was made good by adding the requisite amount of tap water. Daily observations were made on the germination of seeds. At the end, the seedlings were harvested and length of radicle and plumule were measured and fresh and dry weights of the seedlings were recorded.

The moisture content of the seedlings was determined as follows:

$$\text{Moisture content, \% seedling oven dry weight} = \frac{\text{Fresh wt.–Oven dry wt.}}{\text{Oven dry wt.}} \times 100$$

The data obtained on the seed germination and measures of seedling growth was subjected to analysis of variance (Anova).

RESULTS

***Pennisetum americanum* cv.Tiftlate synthate:** The seed germination was much faster in treatments B and C as compared to that in treatments A and D. In treatment D only 11.66% germination was recorded (Fig. 1). There were no significant differences among various treatments with

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Table 1: Growth measurements per seedling of *Pennisetum americanum* cv. Tiftlate synthate grown in different treatments of soil moisture levels

Treat-ments	Radicle length (cm)	Plumule length (cm)	Fresh weight (g)	Dry weight (g)	Moisturecontent, %seedling oven dry weight
A	1.83	2.33	0.08	0.01	508.33
B	8.11	9.58	1.13	0.11	983.62
C	5.76	8.47	1.03	0.07	1448.00
D	1.95	3.19	0.19	0.02	703.33
LSD (P=0.05)	*N.S.	*N.S.	0.62	0.02	498.24

Table 2: Growth measurements per seedling of *Pennisetum americanum* cv. IC-8206 grown in different treatments of soil moisture levels

Treat-ments	Radicle length (cm)	Plumule length (cm)	Fresh weight (g)	Dry weight (g)	Moisturecontent, %seedling oven dry weight
A	2.81	3.18	0.07	0.01	366.66
B	9.73	11.43	0.76	0.08	871.32
C	4.03	8.38	0.61	0.06	949.44
D	3.05	8.06	0.08	0.02	361.11
LSD (P=0.05)	*N.S.	4.42	0.38	0.01	387.52

*NS = Not Significant
A = 50% of Field Capacity (Water deficit)
B = 100% of Field Capacity (Control)
C = 150% of Field Capacity (Slightly flooded)
D = 200% of Field Capacity (Flooded)

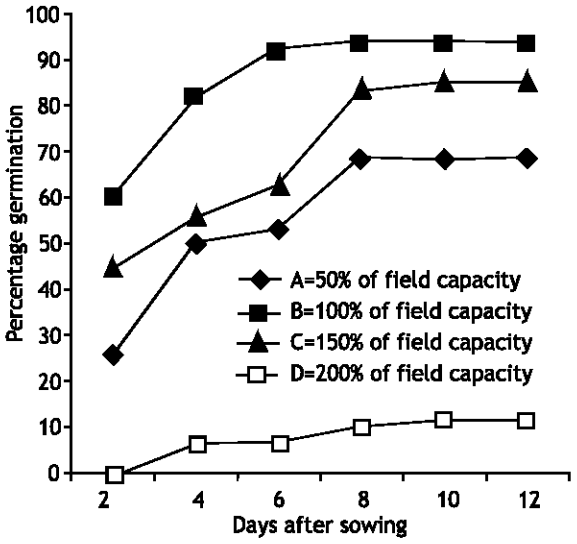

Fig. 1: Mean values of percentage germination of seeds of *Pennisetum americanum* cv. Tiftlate synthate in different treatments of soil moisture levels

regards to radicle and plumule lengths while significant differences among various treatments with regard to fresh weight, oven dry weight and moisture content of the seedlings were observed. The seedlings of treatments B and C performed better than those of treatments A and D. (Table 1).

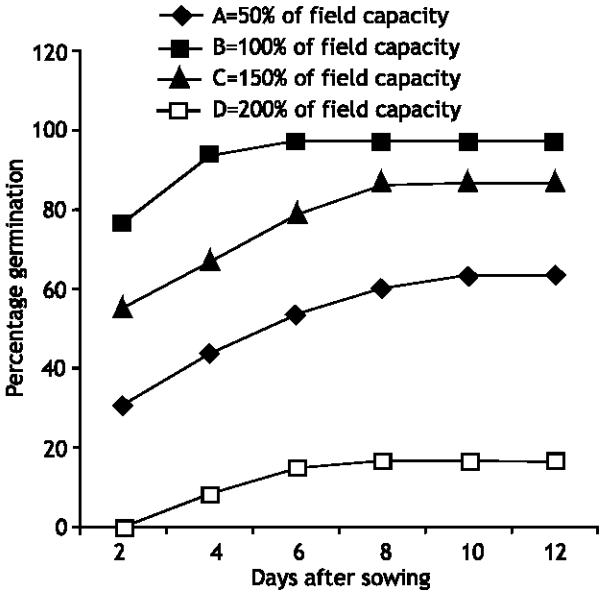

Fig. 2: Mean values of percentage germination of seeds of *Pennisetum americanum* cv. IC-8206 in different treatments of soil moisture levels

***Pennisetum americanum* cv. IC-8206:** The rate of seed germination in treatment B was much faster as compared to that in treatments A, C and D. Much slower rate of seed germination was recorded in treatment D.In treatment B, maximum germination occurred while in treatments A and C, moderate germination was recorded, respectively. In treatment D only 16.66% germination was recorded (Fig. 2). There were no significant differences in radicle length of the seedlings of different treatments. There were significant differences among the various treatments with regard to the length of plumule, fresh and dry weights and moisture content of the seedlings. On the whole, the seedlings of treatment B had significantly longer radicle and plumule lengths, fresh and dry weights than those of treatments A, C and D (Table 2).

DISCUSSION

The effects of various soil moisture levels on seed germination and seedling growth of two cultivars of *Pennisetum americanum* L. (Tiftlate synthate, IC-8206) revealed that the seed germination was maximum at moderate moisture levels than at the lowest or the highest ones. However, the better germination of seeds may not be taken as a measure of drought and water logging tolerance of these cultivars.

Maximum potential of a crop is never attained under natural conditions because of limitations imposed by

salinity, drought and water logging and other environmental stresses[17-19]. The main objective of the work reported here was to introduce the cultivars of *Pennisetum americanum* which may tolerate the stresses and to search out the moisture levels at which maximum growth can occur. The results for germination of two cultivars of *Pennisetum americanum* presented here showed similar response to different levels of soil moisture. Percentage germination was lower in D (Flooded) treatment in both the test cultivars. The possible reason for lower percentage of germination in this waterlogged treatment may be anaerobic situation of that treatment.

Delay and slower rate of germination was recorded in treatment A. Slow rate of germination observed here can be attributed to lesser water availability necessary for imbibition and germination processes[20,21]. The reduction in various growth measures in water logged condition is well documented[22-25].

The results of the studies reported here have revealed that both the cultivars Tiftlate synthate and IC-8206 performed better regarding seed germination as well as various growth measures at moderate soil moisture levels but at much lower and much higher moisture levels growth of plants was inhibited.

It was recorded that seed germination was better in drought condition than in water logged condition. This indicated that both the cultivars, Tiftlate synthate and IC-8206 were intermediate in drought tolerance but these were sensitive to water logging.

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