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Study on Yield and some Physiological Criteria of Pearl Millet under Effect of Drought Stress and Nitrogen Fertilizer

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ABSTRACT

In this research, the effect of drought stress were investigated on pearl millet (pennistumamericanuml .leek), three periods of irrigation (7,14 and 21 days period of irrigation) an three level of nitrogen fertilizer (0, 150 and 300 kg/ha) in three replication were used yield, growth analysis and some physiological characteristics were studied. Some characteristics like total dry weight, leaf area index, leaf dry weight / total dry weight ratio, chlorophyll a,b were measured. Result showed that 21 day period of irrigation for this crop is enough and after establishment of the plant, there is no need to water the plant .300 kg /ha nitrogen fertilizer had The most effect on total dry weight as well. There were no statistics significance chlorophyll a, b and the total chlorophyll (a +b), between different periods of irrigation and nitrogen fertilizer. In general, results of growth analysis showed that 7 day period of irrigation and 300 kg / ha nitrogen fertilizer had the higher leaf area index. Result of growth analysis compared with total dry weight showed that after establishment of the plant 21 days period of irrigation as well as 300kg / ha nitrogen fertilizer will produce higher yield.

Keywords: drought stress, nitrogen fertilizer, pearl millet.

INTRODUCTION

The role of forage plants in grassing livestock and supplying human demands to these productions is of undeniable significance. Unfortunately, the production and management of forage plants are not considered significantly in comparison to other productions. Totally, dry forage production in Iran is only 27 million tons annually that 10 million tons is supplied from pastures, 8 million tons from forage plant cultivation, 7 million tons from fields and agricultural production remainder and 3.2 million tons from importing. On the basis of FAO reports in 1989 [1], about 3.29×10^9 hectares of pastures are under cultivations of livestock productions which is 34% of the world fields.Iran is of dry and semi-dry regions. The population growth and increase of food demands especially protein causes a great need of having plants with high tolerance to soil conditions and minimum demand of water supply i.e. we need plants of minimum water demand and high dry material production.

Nutritive millet is a summer forage hybrid with high quality. It is a pennisetum which entered global markets after various field studies in 1989 by an Australian producer company. The millet imported Iran in 1991 in order to have some studies over its environmental compatibility. Nutritive parents are both pennisetum and one of the most significant pro of this plant is its late-flowering which is caused by ripeness of its parents. Parents participate in existing leafy hybrids which produce high protein and digestion. A high ration of leaf to stem (2-3 times more than grained sorghum) has made this plant of high palatability and feed value and of low remainders. Seed of nutritive millet is several times bigger than the seeds of most annual forage pennisetums which leads to a better and easier placement in fields (Slatter and Stuart 1995). Bigger seeds will produce higher plants with more leafs, primary and complete observations under soil moisturize stress. This characteristic is of high significance in utilizing sorts of bigger seeds in dry centers.

Dryness stress leads to palatability of plant and high level of alkaloids. This can be seen in elder plants which decreases forage palatability (reported in a research in central Queensland in dry regions of Australia) [2]. In the case that there is sever pasture or successive harvests, nitrogen should be fertilized in order to keep quality of produced forage and increase of dry material quantity. Then, nutritive will response well to this increase. The best date is reported 14 April to 5 May in Ahvaz in order to cultivate nutritive millet [3]. The best date is introduced 5 March to 5 April in Safi Abad of Dezful along some similar researches [4]. Some studies are carried out on dryness stress effect on qualitative and quantitative performance of nutritive millet, effect of water stress and cutting branches in Karaj [5]. The absorption of nitrogen by pearl millet was in the highest level during before flowering stages (40 days after cultivation). Utilization of nitrogen fertilizer represents a higher productivity during 4 fertilizing stages in comparison to 2-3 stages [6].

MATERIALS AND METHODS

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This research was performed in a field of agriculture faculty in Islamic University of Karaj which located in geographical position of 51°, 59' eastern, geographical latitude of 35°, 48' northern and a height of 1313m from sea level. This region is classified as semi-arid region according to Ombrothermic curve. The mean annual raining of region was reported 257mm and was related mostly to late of autumn and spring. The maximum annual temperature was 26° in Teer month and the minimum temperature was 1.2° in Day month. The soil of site was loam-sand.

Kurt of this experiment was in the form of completely random blocks in 3 replicates. Main factor consisted various irrigation periods (every 1, 2 and 3 weeks) and the minor Kurt of 3 urea fertilizers (0, 150 and 300kg/hectare). The distance between replicates was 3m, between main factors was 1.5m and it was 1m between minor factors. Preparing field began by plowing. Cultivating seeds was performed in May 20. In order to have a good green percentage on field, analysis was carried out in June 12. The sparseness of plants should be performed after 3 weeks of cultivation (stage of 3-4 leafs) in order to regulate plant density in surface unit. The irrigation method was leakage in this experiment. Weeding was performed manually every 10 days. The first sampling was done in July 1 and dryness stress and fertilizer treatments began in July 2. Sampling was done every 15 days during plant growth in order to study and analyze of plant growth indices under low level of water and identifying effective factors on plant growth and performance. The sampling was in this method that after omitting 0.5m from the beginning and end of cultivation lines and also omitting aside lines in order to delete marginal effects such as water penetration, sampling was done randomly in the length of 0.5m ($0.25m^2$). 5-6 plants were chosen from mentioned surface and were put into plastic bags and sent to seed reformation and preparation research institute of agriculture faculty in Karaj. The samples were divided into different parts of leaf and stem after weighting. The surface index of leaf was weighed by leaf area meter and was put into paper packets. They were put into oven and they were weighed again by a high accuracy weigh after drying. The amount of chlorophyll a and b was measured through Arnon method when the height of plant was 70cm [7].

RESULTS AND DISCUSSIOS

1. Total Dry Material (TDW)

According to statistics, it can be observed that there is no significant difference for these characteristics from irrigational and fertilizer point but mean comparisons show that irrigational treatment is of the highest performance once a week and fertilizer treatment of 300kg urea is of the highest dry material performance (Graphs 1, 2, histogram1). According to the results of this study, other researchers [7] and insignificance of irrigational treatment, it can be verified that an irrigation of every 21 days is sufficient for this plant in Mard Abad of Karaj and there is no need to weekly irrigation. Also an irrigation of once a month seems to be suitable [7]. It seems that existing nitrogen in phosphate ammonium fertilizer causes no significant difference between various levels of fertilizer treatment.

2. Leaf Area Index (LAI)

A comparison of leaf area index in various periods of irrigation (graph 3) showed that the highest leaf area index is once a week and the lowest index is every 3 weeks. This increase is caused by highness of pressure of this irrigation period to other irrigation levels. Siva kumar[8] concluded that leaf development velocity and relative growth is in a direct relationship to water shortage in soil. They proposed that leaf development can be criteria of soil humidity evaluation. Coax and Julief[9] observed that leaf area index and pure material preparation of soya will be decreased under severe shortage of humidity.

Also it was determined that the third level of fertilizer treatment (300kg of urea) is of the highest effect on leaf area index in comparison to other 2 levels (graph4). The reason of this increase is the positive effect of nitrogenized fertilizer on plan growth which causes the increase of leaf numbers and areas [5,7].

3. The Ratio of Dry Weight to Total Dry Weight (LWR)

This ratio is an index of leaf asset in comparison to dry weight of plant. Relative cost of consumption contains potential photosynthetic parts and is count as criteria of productive asset of plant. The results of variance analysis showed that there is a significant difference of 1% between irrigational and fertilizer levels. The comparison of treatment mean represented that this ration is high in a treatment with irrigation of every 3 weeks. Some researchers such believe in that at first leaf cells grow, leaf area decreases before decrease of photosynthesis take place and even in some cases it is stopped [10].

The fertilizer treatment of 150kg urea is of the highest ratio that it can be observed in day 54 in both irrigational and fertilizer treatments. This ratio will decrease as time passes and plan grows because time passing decreases leaf growth ratio to total dry weight and more photosynthetic material is located in stems. Also, leaf shadowing on each other and their aging will affect decrease of this ratio (graph 3, 4).

4. Chlorophyll (a + b)

The results of variance analysis of chlorophyll a and b showed that irrigational treatment effect on total amount of chlorophyll is not significant but the comparison of treatment mean shows that the treatment of the first irrigational level is of the highest total chlorophyll which shows the deficiency of dryness stress on chlorophyll (histogram2). Also the effect of nitrogenized fertilizer on total chlorophyll is increasing effect and the third fertilizer level is of the highest total amount of chlorophyll (histogram3). The main reason of this process is the role of nitrogen as one of mineral material affective on chlorophyll structure. The results of [5] show that the first irrigational level (RWC=90-95%) is of the highest amount of chlorophyll and treatment under severe stress (RWC=60-65%) is of the lowest amount. Other researches [7] show similar conclusions.

It was showed the effect of dryness stress on chlorophyll decrease related to wheat leafs. The severity of photosynthesis is not affected by chlorophyll because irrigational treatments' effects on chlorophyll are not significant and the amount of plant chlorophyll is normally higher than the demanded amount [10].

Effects of drought and nitrogen fertilizer on yield and some physiological characteristics of pearl millet

S.O.V	df.	Total dry weight t/ha	Leaf area index	Leaf dry weight/ Total dry weight	Chlorophyll (a+b) g/g
Replication	2	13.317 $^{n.s}$	38.312 $^{n.s}$	0.0000786 $^{n.s}$	0.0001848$^{n.s}$
AFactor A	4	1518.1**	1066.4**	0.0208232**	0.0001707$^{n.s}$
Error	8	8.085	26.671	0.0000495	0.001251
BFactor B	2	181.33**	121.80 **	0.0002559 $^{n.s}$	0.0001696$^{n.s}$
AB	8	28.138 *	19.203 $^{n.s}$	0.0002307 $^{n.s}$	0.0001532 $^{n.s}$
Error	20	10.318	15.963	0.0001081	0.0001941
C.V.	-	4.27	5.18	3.90	

* and ** respectively represent significance of 1 and 5 percentages

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