STUDIES ON THE CRITICAL MOISTURE PERIODS IN THE GROWTH SEASONS OF SOME ECONOMICAL CROPS

By

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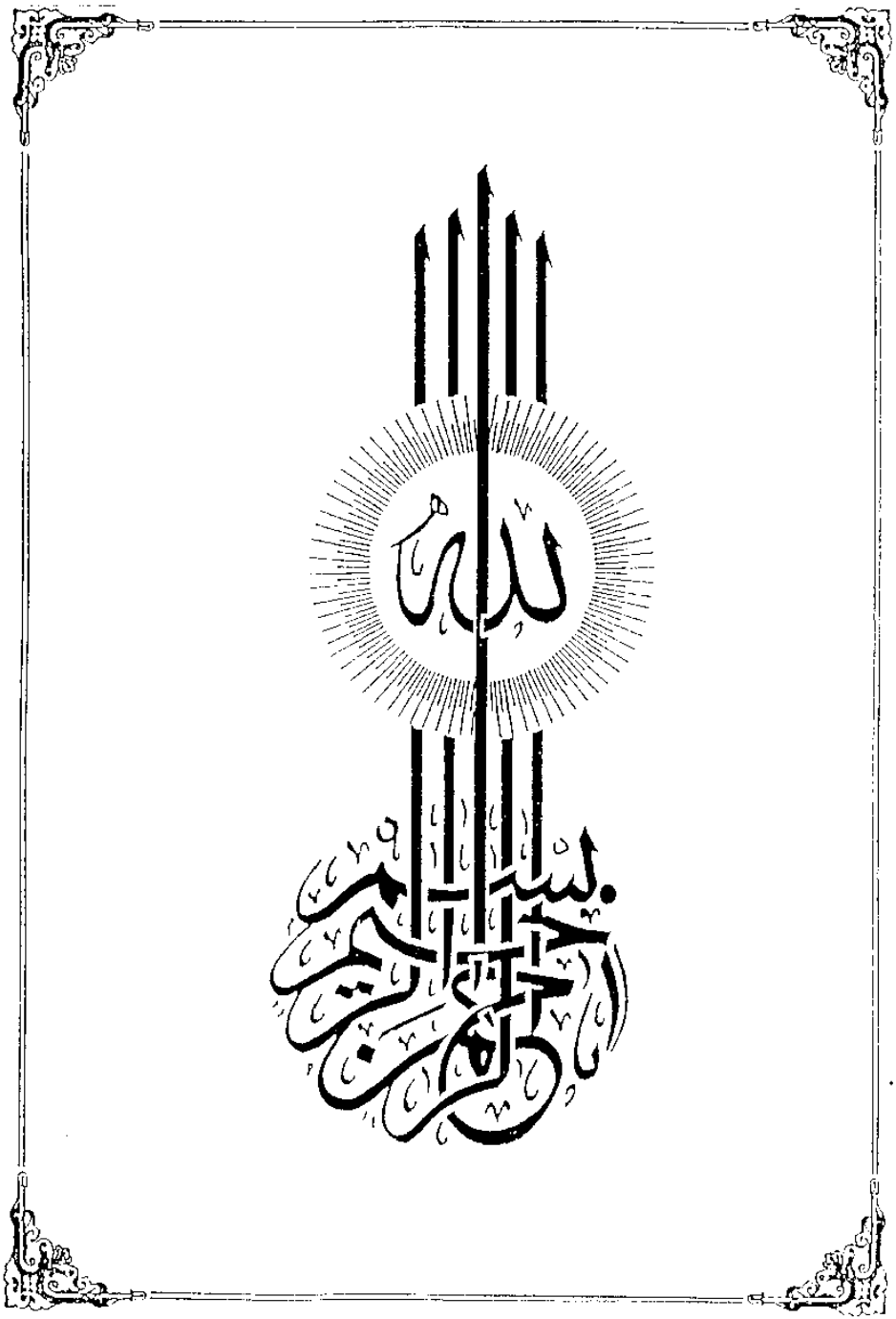

in height stopped. Other treatments had nearly the same type as that of treatments E and F, but it retarded under the influence of high soil moisture stress.

Number of leaves:-

It is clearly obvious that the early drought treatments give the largest decrease in the number of leaves per plant. However, no difference in the number of leaves was observed between treatments D and E, in which soil drought was induced during silking and ripening stages respectively, and the control treatment.

The least number of leaves was obtained in treatments A and B which were dried after seedling and elongation stages, respectively. This could be attributed to the fact that plants at early stages of growth pass through division and elongation of cells as well as through optimum rate of leaves production.

It could be observed from the values presented in Fig. (13) that the correlation between leaf number and plant age was linear in the first 60 days. Thereafter, no increase occurred after tassel appearance. However, the rate of increase varied according to the stage in which soil drought was induced. This was explained as being a result of less number of leaves formed during drought period especially

those after seedling and elongation stages. The leaf number was about 6.0 per plant for the first stage, while for the other stages it was about 9.0 when plant was 30 days old.

Number of internodes:-

Available soil moisture shortage had directly influenced the number of internodes when this condition occurred during early stages of growth, (i.e., after seedling, elongation, or tassel appearance stages), in which the decrease in the number of internodes was highly significant in the afore mentioned order. There was no difference in the number of internodes of plants grown in treatments D, E or F. The drought treatment was induced at later growth stages in the first two treatments, while in treatment F no soil moisture drought was enforced.

The number of internodes at the time of tassel appearance was equal to that of leaves minus one. At early stages, however, the number of internodes was indistinct to their shorter length.

The above data lead to the conclusion that both the number of internodes and leaves were significantly decreased under the influence of drought at early stages of growth, especially before tassel appearance.

Length of internodes:-

The length of internodes was calculated by first measuring the length of the main internal stem of corn and then dividing it by the number of nodes on the same stem. Results indicate that drought period at the tassel appearance had the most decreasing influence on internode length. This influence was the result of shorter stem height and the relatively smaller number of nodes.

Soil drought during elongation (treatment B) and silking (treatment D) stages decreased the final internode length in almost the same degree. This was due to the shorter stem-length and smaller number of nodes in treatment B while in treatment D, the internode length nearly stopped (15.9 to 16.6 cm.) after subjecting its plants to soil drought.

Drought treatments at ripening stage did not influence the internode length at all, since internodes reached their normal length before subjecting the plant to soil drought.

Fresh weight:-

Results of fresh weight are reported in Table (20) and their variation with age in different treatments are illustrated graphically in Fig. (14). The results indicate an increase in fresh weight of overground parts of corn

plants as its age progressed. Maximum weight was reached after 60 days in treatment D, and 75 days in each of treatments A, B, C, E, and F. Thereafter, the fresh weight gradually decreased.

Serious shortage of available soil moisture at early stages of growth, i.e., seedling, elongation or tassel appearance, significantly decreased the fresh weight of the overground parts of corn plants. The main reason for the observed restricted growth under the influence of soil moisture deficient, is the reduction of turgidity of the tissue and the subsquent impairment of physiological processes especially during early stages of growth when maximum activity of growth occurs. In addition, drought at leaf formation stage may result in dryness of lower leaves, delaying the appearance of newly-forming leaves, and supressing their number as well as producing shorter stems.

Fig (14) shows that induced soil drought during tassel appearance stage (treatment C) caused a decrease in fresh weight of plant, followed by an increase at the end of the drought period. This result indicates that the plants reached again their normal rate of growth; i.e., reaching the maximum fresh weight after 75 days old as in treatments A and B. In treatment D, which was subjected to drought during silky stage, the fresh weight of plant increased in

the same ratio as in treatments E and F till 70 days old. Subjecting the plants in this treatment, D, to drought after this period resulted in a general decrease in fresh weight till the end of growth season. So, the effect of drought on the fresh weight of plant differs in the two treatments, causing a permanent effect in treatment D, while a temporary one in treatment C.

The effect of soil drought at ripening stage was not significant since the fresh weight of the over-ground parts was not influenced. Fig. (14) shows that the curve for this treatment coincides with that of treatment F which was not subjected to any drought.

Dry weight:-

Figure (14) clearly indicates the sigmoid shape. Soil drought at elongation, tassel appearance or seedling stages resulted in a decrease in the growth of overground parts. This result may be due to the less number of leaves, shorter stems and, in general, to the tendency of plant to complete its life by early flowering and fruiting under the unfavourable soil moisture conditions during these early stages of growth. However, when such condition are induced at later stages of growth, they did not show a significant influence on dry matter production. This is clear from the result of treatment E (ripening stage) which took the same trend of

dry weight as treatment F. These observations are greatly supported by the findings of Rhoades and Nelson (1955) who stated that moisture deficiencies after silking had, but a little effect, on vegetative growth of corn plant.

Fresh: dry weight ratio:-

Statistical analysis of the results which were recorded at the end of growth season reveal that only in treatment E (moisture deficite during ripening stage) there exists a significant decrease in fresh/dry weight ratio. This is because the drought period was induced towards the end of the growth season and plants did not receive any irrigation after this drought period. These results signify that in drought periods during elongation, tassel appearance and after seedling stages, a sharp drop in the curve of fresh / dry weight ratio was obtained. Although this drop was followed by an increase after irrigation, yet the curves of treatemnts B and D indicate lower values than those of treatments E and F.

It may be concluded that high soil moisture stress, particularly at early stages of corn growth, resulted in a lower water content of the overground parts which is shown by lower ratios of their fresh/dry weights.

Growth rate:-

Growth rate is defined as the increase in weight of overground parts of the plant, calculated as grams of dry matter per day. This value was calculated periodically throughout the growth season, and the results are presented in Table (20) and expressed graphically for the different treatments in Fig. (15).

The maximum growth rate was reached at the age of 60 days in treatments B and D, 75 days in treatments A, E and F and 90 days in treatment C. This delay was a result of subjecting plants to drought at a critical period of plant growth. Fig. (14) shows also that the growth-rate curves for the season were normal, in general, for treatments A, B, E and F although with varying values.

The curve for treatments C, on the other hand, shows two peaks, one at the age 45 days and the other which is much higher, at 90 days. Hence, it may be concluded that soil drought at tassel appearance stage resulted in a sharp drop in the growth rate at the 60 days, followed by an increase although much lower than that of treatment F which was not subjected to any drought. It seems that the plant continued its vegetative growth after drought period was ended.

Highest rate was attained in treatment F followed by treatments E, A, D, C &B in a decreasing order. The lowest

late reached in treatment C is an indicator that soil drought at elongation stage had badly influenced the growth rate since an ample supply of soil water was needed for the relatively vigorous plant growth during this stage.

Soil moisture stress at ripening stage, treatment E, did not affect the growth rate as it took the shape and almost the magnitude of the control treatment F.

4.2.3 The influence of drought on the yield:-

The influence of high soil mositure stress at different growth stages of corn plant on the yield of grains, grains plus cobs, stalks, number and length of ear, shelling percentage and 100 kernels weights are shown, by the data presented in Table (21) and illustrated graphically in Figures (15 & 16).

Generally, high soil moisture stress showed a considerable effect on the various characteristics of yield, especially the grain weights and shelling percentages. The influence on yield may be considered as the most important criteria which reflects all previously discussed properties of corn plants.

Yield of grains:-

Significantly lower yields of grains plus cobs were obtained under the influence of high soil moisture stress at

The influence of high soil moisture stress, at different stages of corn growth, on weight of grains, weight of stalks, shelling percentage, stalks/grain ratio, number of ears and ear length per plant, and weight of 100 kernels.

Character under study		Treatments						L.S.D. 5%
		A	B	C	D	E	F	
Per Feddan :								
Grains *	Ton	2.587	2.070	1.966	2.546	3.633	4.347	0.69
Grains plus cobs *	Ton	3.115	2.505	2.691	3.469	4.316	4.999	0.45
Stalks								
Fresh weight	Ton	8.911	7.866	9.129	10.505	10.929	12.824	0.82
Dry weight * *	Ton	4.036	3.674	4.233	4.896	5.402	5.123	0.43
Stalks / grains ratio * *		1.72	1.96	2.37	2.13	1.65	1.31	
Shelling percentage		83.00	82.60	73.00	73.40	84.10	86.90	0.43
Weight of 100 kernels	g.	37.20	36.80	33.70	32.90	34.90	38.90	0.41
Number of ears per plant		1.23	1.08	1.02	1.09	1.89	1.95	0.08
Length of ear	cm.	19.70	18.70	16.90	19.20	24.90	25.10	[illegible]
Per Plant :								
Grain	g.	183.1	155.9	145.2	179.6	252.0	317.4	[illegible]
Grain plus cobs	g.	220.6	188.7	198.9	244.7	300.0	365.2	[illegible]
Stalks								
Fresh weight	g.	648.6	597.2	670.5	742.6	759.7	856.7	[illegible]
Dry weight	g.	274.1	262.2	302.3	335.6	353.8	314.0	[illegible]

* Based on 30 days after harvest

* * Based on oven dry weight, at 105° C.

any growth stage, being highly significant at elongation or tassel appearance stages. However, the degree of influence of increased soil moisture stress was lessened, if it were induced after seedling or during silky stages as well as in the ripening stage, whereas a slight decrease in the yield was observed.

This was to a great extent, due to the application of moisutre treatment after nearly all the main critical growth processes had been completed.

Since grain yield is the economic product of this plant, hence treatment C was found to be the most influencing one in decreasing the yield. Relatively less affected were treatments B, D followed by A, although no significant difference between them was detected. The grain yields were, 1.966, 2.070, 2.546, 2.587, 3.633 and 4.347 tons per feddan for the treatments C, B, D, A, E and F respectively.

From the obtained results, it could be concluded that soil moisture shortage in the root zone of corn plant during the first 70 days of its life, i.e., till silking stage had badly influenced the grains yield. In this connection, Rhoades and Nelson (1955) reported that a deficiency of water during tasseling and silking sharply lowers the yield.

It could be recommended, therefore, that the critical periods of high soil moisture stress in the life of

corn plant were the elongation and tassel appearance stages in which grain weights were greatly decreased. However, grain yield from treatment F which was not subjected to soil drought, was relatively very high as a result of well-balanced soil moisture content which was controlled by affording favourable frequencies and amounts of irrigation water.

Weight of stalks:-

The results of stalks are illustrated in Fig. (15). Statistical analysis reveal that soil drought has significantly decreased the fresh and dry weights of stalks when drought was enforced at early stages of growth, i.e., at elongation, tassel appearance or after seedling. Yet, there was no significant difference between the yield of stalks from the later two stages. This result could be explained by the relatively lower water content and the limited vegetative growth of the over-ground parts of plants in these treatments. At later growth stages, i.e., at silking and ripening, however, the influence of high soil moisture stress on the dry weight of stalks may be considered negligible and the difference in yield between the two treatments was not significant.

Thus, it may be stated that critical soil moisture shortage during the elongation, after seedling or tassel

appearance of corn plant significantly decreases the yield of stalks.

Stalks: grain ratio:-

Results indicate obviously that soil drought during tassel appearance stage was significantly critical, since it showed a high ratio of stalks to grains. This may be due to very low production of grains with respect to the production of stalks in this treatment. In addition, plants in treatments D and B were also very low in their efficiency for the production of grains. This could be mainly attributed to the unfavourable influence of soil drought on the production of grains contrary to its effect on stalk weights especially at silking stage.

On the other hand, the ratio of stalks to grain weights was relatively lower for treatments F and E which were subjected to drought during ripening stages. In these two treatments, the production of both stalks and grains was efficient and the weight of stalks was not influenced by soil drought at ripening stage.

Shelling percentage:-

Shelling percentage is defined as the percent of grain weight to grains plus cobs indicating the efficiency of corn plants in grain production (Fig. 16).