EFFECT OF DEFOLIATION ON YIELD AND SOME OTHER CHARACTERS OF MAIZE SINGLE CROSSES

Aziz-ur-Rehman and M. Asghar Mian
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad

Seven defoliation treatments were applied at three leaf growth stages. It was found that yield response to defoliation increased as the defoliation treatments were applied closer to the critical pollination period. Defoliation at 8 and 10-leaf stages greatly affected the yield and yield components. The greatest reduction was produced by 100% full leaf defoliation for 100-grain weight, ear length, ear diameter and grain yield. Minimum reduction was noted by the application of 25% half leaf defoliation in most of the characters under study.

INTRODUCTION

Defoliation of maize at any stage of development has generally decreased final grain yield per plant (Allison *et al.*, 1975; Cloninger et al., 1974). Defoliation during silking resulted in greater yield reduction with little or no yield reduction following leaf removal at very early or very late growth stage. Johnson (1978) found after defoliating full season and early maize hybrids that defoliation generally reduced average yield regardless of the maturation period. Pinter (1980) reported that reduction in yield was attributable primarily to decrease in length of grain-covered portion of the ear followed in order by fewer grain rows and reduced 100-grain weight. Jones and Simmons (1981) reported defoliation reduced weight per grain. Barnett (1982) reported that defoliation decreased ear and grain weight. Vasilas and Sief (1985) reported that defoliation reduced grain yield because of reduced kernel size, ear number, and kernels per ear. The present studies were planned to evaluate the genotypic response of corn single crosses to defoliation and the effects of various degrees of defoliation at different leaf stages for grain yield and other characters.

MATERIALS AND METHODS

The studies reported were conducted in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during 1989, the treatments to study the effect of various degrees of defoliation were made on two single cross hybrids from four local and exotic inbred lines of *Zea mays* L.

The parental inbred lines, Iman 54, JR, GPD 25 and W187R-5 were grown in the field during spring 1989 to obtain two single crosses (Iman-54 x GPD25 and JR x W187R-5). Single crosses were sown during August 1989 following randomized complete block design, in a split-split-plot arrangement with single crosses as main plots, growth stages as sub-plots and treatments as sub-sub plots. Each entry consisted of two 76cm apart rows of 4.5 meter length with row to row distance of 23cm. Seven defoliation treatments were applied at three growth stages i.e., 1) Control; no leaf removed. 2) 25% full leaf defoliation; every third full leaf blade was removed. 3) 50% full leaf defoliation; every other full leaf blade was removed. 4) 100% full leaf defoliation; all full leaf blades were removed. 5) 25% half leaf defoliation; every

third half leaf blade was removed. 6) 50% half leaf defoliation; every other half leaf blade was removed. 7) 100% half leaf defoliation; all half leaf blades were removed. The three growth stages were: 1. six leaf stage; stage of growth when the 6th leaf has expand enough to be arched over. 2. eight leaf stage; stage of growth when the 8th leaf has expanded enough to be arched over. 3. ten leaf stage; stage of growth when the 10th leaf has expanded enough to be arched over.

All treatments were made by cutting full and half leaf blades manually using a razor blade. The distal half of all exposed leaf blades was removed for half leaf defoliation.

RESULTS AND DISCUSSION

The differences among the genotypes were non-significant, while treatments and growth leaf stages differed significantly (Table 1). The reduction in 100-grain weight (Table 2) with 25% half leaf defoliation was minimum at 6-leaf stage, while 100% full leaf defoliation produced maximum reduction at all the three stages in both single crosses. At 8-leaf stage (Table 3) 100% full leaf defoliation produced maximum effect (13.58g) compared to control (21.1g). Ten-leaf stage was the most critical stage, produced maximum effect by all the treatments compared to other stages. Maximum effect was produced (Table 4) by 100% full leaf defoliation (12.49g) compared to control (22.67g). As shown by the data in Table 2, 25% half leaf defoliation treatment caused minimum reduction for ear length (13.5cm) at 6-leaf stage compared to the control, while 100% full-leaf defoliation produced maximum reduction (11.55cm) in single cross IMAN 54 x GPD 25. At 8-leaf stage (Table 3), 25% half leaf defoliation caused minimum effect while 100% full-leaf defoliation produced maximum reduction (10.49cm) in single cross JR x W187R-5 compared to the control (15.10cm). Ten-leaf stage caused maximum effect (Table 4) by 100% full-leaf defoliation (9.93cm) in single cross JR x

Table 1 Mean squares analysis of variance for the effect of defoliating two corn single crosses on grain yield and yield components

Source of Variation	d.f	100-kernel weight (gm)	Ear lenght (cm)	Ear diameter	Grain yield (gm)
Replication	2	5.101	5.438	0.002	568.953
Single Crosses(SC)	1	0.093	2.571	0.002	182.33
Error (a)	2	1.085	1.417	0.022	208.90
Leaf Stages (LS)	2	35.783**	1.22	0.729**	2963.54**
SC x LS	2	3.882	392*	0.051	209.912
Error (b)	8	2.120	0.435	0.016	257.59
Defoliation Treat. (TR)	6	79.172**	25.916**	1.509**	6511.432
SC x TR	6	3.03	0.416	0.063	54.679
LS x TR	12	3.64	1.631*	0.241**	373.041*
SC xLSxTR	12	1.788	0.725	0.039	172.306
Error (c)	72	1.708	0.841	0.034	155.094

*,** Significant at the 0.05 and 0.01 probability level, respectively.

Table 2 **Effect of defoliaation at 6–leaf stage on yield and some other characters of two maize single crosses**

Single Crosses	Treatment		100–KW (g)	Ear lenght (cm)	Ear diameter(cm)	Grain yield (g)
IMAN 54 x GDP 25	0		20.65	14.30	4.03	101.08
	25 %	FLD	18.45	12.71	3.82	77.48
	50 %	FLD	18.32	12.43	3.61	77.99
	100 %	FLD	17.83	11.55	3.58	67.92
	25 %	HLD	20.39	13.59	3.86	95.00
	50 %	HLD	19.39	13.43	3.89	97.63
	100 %	HLD	18.31	12.82	3.83	70.56
JR x W 187 R–5	0		22.20	15.07	4.11	96.11
	25 %	FLD	18.86	13.28	3.83	73.33
	50 %	FLD	16.93	12.82	3.78	70.28
	100 %	FLD	16.76	12.40	3.57	57.64
	25 %	HLD	19.34	13.94	3.92	92.78
	50 %	HLD	19.18	13.51	3.80	93.34
	100 %	HLD	17.01	13.29	3.62	63.67

FLD = Full leaf defoliation
HLD = Half leaf defoliation

Table 3 **Effect of defoliaation at 8–leaf stage on yield and some other characters of two maize single crosses**

Single Crosses	Treatment		100–KW (g)	Ear lenght (cm)	Ear diameter(cm)	Grain yield (g)
IMAN 54 x GDP 25	0		21.10	14.83	4.07	92.57
	25 %	FLD	19.25	13.33	3.75	72.22
	50 %	FLD	16.83	12.76	3.67	66.13
	100 %	FLD	13.58	11.28	3.39	29.31
	25 %	HLD	19.40	13.38	3.81	74.21
	50 %	HLD	18.36	13.27	3.78	85.14
	100 %	HLD	17.20	12.47	3.75	71.89
JR x W 187 R–5	0		21.92	15.10	4.08	93.92
	25 %	FLD	17.94	12.89	3.95	73.27
	50 %	FLD	16.12	11.25	3.66	47.00
	100 %	FLD	14.93	10.49	3.32	30.00
	25 %	HLD	18.75	13.48	3.66	84.86
	50 %	HLD	18.36	13.49	3.80	72.83
	100 %	HLD	17.56	12.74	3.49	57.22

FLD = Full leaf defoliation
HLD = Half leaf defoliation

W187R-5 compared to the control (15.35cm).

The removal of the small part of photosynthetic system of plant in 50% half leaf defoliation treatment (Table 2) at 6-leaf stage resulted in only a slight decrease in ear diameter in single cross IMAN 54 x GPD-25. Maximum decrease in ear diameter resulted by 100% full leaf defoliation at 10-leaf stage. Maximum decrease in ear diameter at this growth stage (Table 4) produced by 100% full leaf defoliation (2.58cm) compared to the control (4.14 cm) in single cross JR x W187R-5. From the results (Table 2), it is noted that at 6-leaf stage, minimum reduction in grain yield per plant was produced, while ten-leaf stage was the most critical which caused maximum reduction in yield. Maximum reduction resulted by 100% full-leaf defoliation (17.08g) compared to the

Table 4 **Effect of defoliaation at 10−leaf stage on yield and some other characters of two maize single crosses**

Single Crosses	Treatment		100−KW (g)	Ear lenght (cm)	Ear diameter(cm)	Grain yield (g)
IMAN 54 x	0		20.67	14.30	4.08	95.73
GDP 25	25 %	FLD	16.49	13.28	3.68	58.75
	50 %	FLD	14.53	11.63	3.60	47.08
	100 %	FLD	13.31	9.56	2.73	17.08
	25 %	HLD	18.26	13.60	3.68	74.16
	50 %	HLD	17.83	13.10	3.67	75.36
	100 %	HLD	16.22	11.50	3.07	67.08
JR x	0		22.67	15.35	4.14	92.53
W 187 R−5	25 %	FLD	17.14	14.26	3.79	70.83
	50 %	FLD	16.28	13.06	3.78	65.00
	100 %	FLD	12.49	9.93	2.58	18.44
	25 %	HLD	18.19	13.85	3.83	71.64
	50 %	HLD	17.96	13.71	3.90	80.42
	100 %	HLD	16.97	13.23	3.11	66.83

FLD = **Full leaf defoliation**
HLD = **Half leaf defoliation**

control (95.73g) in single cross IMAN 54 x GPD-25.

It is concluded from the results that yield reductions due to defoliation treatments in the study were primarily due to smaller ears on each defoliated plant, lesser weight and number of grains per ear. Yield response to defoliation increases as the defoliation treatments were applied closer to the critical pollination period. Defoliation at 8 and 10-leaf stage greatly affect the yield and other characters than at 6-leaf stage.

REFERENCES

Allison, J.C.S., J.H.Wilson and J.H. Williams. 1975. Effect of partial defoliation during the vegetative phase on subsequent growth and grain yield of maize. Ann. Appl. Biol. 81:367-375 (Field Crop Abstr

29:3663, 1976).

Barnett, K.H. 1982. Physiological observation of maize genotypes differing in source-sink ratios. Dissertation Abstr. Int. 42:26-36 (Field Crop Abstr. 37:1008, 1984).

Cloninger, F.D., M.S.Zuber and R.D. Horrocks. 1974. Synchronization of flowering in corn (Zea mays L.) by clipping young plants. Agron. J. 66:270-272.

Johnson, R.R. 1978. Growth and yield of maize as affected by early season defoliation. Agron. J.70:995-998 (Pl. Br. Abstr. 50:2850, 1980).

Jones, R.J. and S.R. Simmons. 1981. Effect of altered source sink ratio on growth of corn kernels. Agron. Abst. 8 (Field Crop Abstr. 35:6493, 1982).

Pinter, L. 1980. Effect of leaf area reduction on grain yield and yield components in maize hybrids with different genotypes. Acta Agronomica Academiae Scientiarum Hungaricae 29(3/4):359-364. (Pl. Br. Abst. 51(10):8826; 1981).

Vasilas, B.L. and R.D. Seif. 1985. Pre-anthesis defoliation effects on six corn inbreds. Agron. J. 77(6):831-835.