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EFFECT OF THE BRACTEAL LEAF ON YIELD OF GRAIN IN SUNFLOWER

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SUMMARY

The bracteal leaf, the nearest "source" to the "pool" of grain, increases the photosynthetic area and efficiency of sunflower and its removal reduces the grain yield by 1.9-7.6% in an edible variety and by 1.8-5.1% in a high oil one. Except for the mechanical injury when the bracteal leaf is removed, the effects of pruning off the bracteal leaf on grain yield agreed with Pereita's (1978) results who stated that 5% of grain yield were supplied by the ten leaves located on the basal part of the sunflower stem.

Measures should be taken to promote and safeguard the growth of the bracteal leaf. Selection for the area of the bracteal leaf and gradient and size of flower disc should also be conducted in breeding programs. According to A.N.RYTAEB the area of the bracteal leaf is a quantitative trait which can be set as an objective and improved in a sunflower breeding program.

INTRODUCTION

Photosynthesis can be carried out by the bracteal leaf of some crops, and its products can be transported into the reproductive organs and thus contribute to the economic output of the crop. Patil (1978) and Gantrill et al. (1980) studied the effect of the bracteal leaf on the grain yield in corn. They declared that 2.6-9.2% of the dry materials in the grain were supplied by the bracteal leaf. Rao (1980) and Sathe et al. (1981) tested the effect of the bracteal leaf on cotton buds. It was proved that 2.6-11.6% of the organic substances were provided by the bracteal leaf to the grain and fibre of cotton. Contrary results have also been reported that the economic yield is not affected by the bracteal leaf.

The rate of grain yield increase contributed by the different leaves of sunflower has been studied by many researchers in different countries. Yet the physiological effects and the potential influences of the green bracteal leaf, located on the edge of the flower disc, on grain yield, have not been quantified. A tests on the bracteal leaf removal were conducted to detect the effects of the bracteal leaf on grain yield in Nuongan County, Jilin Province, in 1981 and 1982.

MATERIAL AND METHOD

A confectionery variety, "Beikui number 15", and an oil-type variety, "Advanced worker", were used in this study. Experiment plots were located on the meadow cherno-

zem soil, medium fertilized with 1000 kilograms per mu of farm manure as the basic source of nutrients. The preceding crop was corn. The distance between rows was 60 cm, with 80 cm between plants for the confectionery variety (1362 plants/mu), while the distance between rows for the oil-type variety was 60 cm with 40 cm between plants. Data and methods of sowing and cultural practices were the same as in normal fields.

Because the two varieties differed in maturity, plant height, leaf area and plant density, they were tested in separate plots. Pruning away the bracteal leaf (from its basis) 100%, 75% (pruning 3 out of every 4 pieces), 50% (pruning 1 out of every 2 pieces), and 25% (pruning 1 out of every 4 pieces) were done at flower bud stage, flowering stage and grain filling stage for each variety. Bracteal leaves were left intact in the check treatment. Experimental design was a randomized complete block with four replications. Each plot included one treatment, and 30 plants were sampled in each plot and means of two years were computed as the final results.

RESULTS AND DISCUSSION

The effect of pruning away the bracteal leaf on grain yield varied in dependence of the time and extent of pruning as well as the type of variety.

The grain yield components of the contectionery variety "Beikui number 15" after removing different numbers of bracteal leaves at different stages are shown in Table 1.

Table 1 shows that the grain number of a single plateau decreased, the rate of empty shell incrased and grain yield droped regularly in the pruned variants as compared with

Table 1. The effect of pruning away the bracteal leaf on grain yield of confectionery sunflower

Grain yield component		Flower bud stage				Flowering stage				Grain filling stage				Check
		100**	75	50	25	100	75	50	25	100	75	50	25	
Grain no. of a single plateau	No. of grains	1234	1268	1299	1325	1265	1288	1304	1320	1345	1348	1349	1352	1352
	Decrease compared with check (%)	8.8	6.3	4.3	2.1	6.5	4.8	3.6	1.7	0.6	0.4	0.3	0.1	
1000-grain-weight	Gram	93.3	92.4	90.1	88.2	92.5	90.8	89.2	87.6	84.3	84.7	85.5	86.1	86.4
	Percentage of chech (%)	108.0	106.9	104.3	102.1	107.1	105.9	103.2	101.3	98.0	98.5	99.8	99.9	100.0
Rate of empty shells	%	37.1	34.6	32.6	30.4	34.8	33.1	31.9	30.0	28.7	28.6	28.6	28.4	78.3
	Percentage of check (%)	131.1	122.3	115.2	107.4	123.0	116.9	112.7	106.0	102.1	101.4	101.0	100.3	100.0
Grain yield	Kg/mu	147.0	152.0	153.6	156.3	151.5	153.6	154.8	156.6	156.1	156.7	157.5	159.1	159.1
	Decrease compared with check (%)	7.6	4.5	3.5	1.8	4.8	3.5	2.7	1.6	1.9	1.5	1.0	0.3	

* 100, 75, 50, 25 in Table 1 are percentages of pruning away the bracteal leaf

the check. The earlier the bracteal leaf was pruned, the larger the range of influence on grain yield.

The ovary develops during the flower bud stage, during which the vegetative and reproductive growing occur simultaneously. The supply of photosynthetic products must be ensured during this stage. The bracteal leaf is the nearest "source" to the reproductive organs. The development of ovary was restrained after pruning away the bracteal leaf, which caused a sudden stop of nutrients transports, with the results of withering and degeneration of the ovary. Thus grain yields were decreased for the decrease of the grain number of a single plateau and the increase of rate of empty shell. Meanwhile, more photosynthetic products were transported into normal grains, which caused an increase of 1000-grain weight.

The reproductive processes, such as the development of the pistil, the stamen and pollination, were effected by a sudden decrease in nutrients supply after the bracteal leaves were removed. And then the rate of normal grain number of a single plateau were reduced, and the rate of empty shell was increased. Generally, the effects were more severe when the pruning took place at the flower bug stage than at the flowering stage (Figure 1).

The effect of pruning off the bracteal leaf during grain filling stage was the lowest. Grain number per single plateau and rate of empty shell were not changed significantly as compared with the check.

Becaue the process of grain filling was affected bu the removal of the bracteal leaf, which made a decrease of grain plumpness of 1000-grain-weight, grain yield was slightly reduced also.

Table 2. The influence of pruning away the bracteal leaf on grain yield of oil-type sunflower

Grain yield component		Flower bud stage				Flowering stage				Grain filling stage				Check
		100**	75	50	25	100	75	50	25	100	75	50	25	
grain No. of a single plateau	No. of grains	767	7.0	797	809	772	791	800	812	816	817	818	819	820
	Decrease compared with check (%)	6.5	4.8	2.8	1.4	4.6	3.6	2.5	1.0	0.5	0.3	0.2	0.1	-
1000-grain-weight	Gram	70.8	69.5	57.9	67.0	69.4	68.4	67.1	65.6	62.8	63.5	63.8	64.1	64.2
	Percentage of chech (%)	110.2	108.2	105.7	104.3	108.3	106.5	104.5	102.2	97.8	98.9	99.3	99.8	100.0
Rate of empty shells	%	42.6	40.4	38.1	36.6	39.8	37.2	36.3	35.7	35.2	35.1	35.0	34.9	34.9
	Percentage of check (%)	122.0	115.7	109.1	104.8	113.7	109.4	104.0	102.2	100.9	100.8	100.2	100.0	100.0
Grain yield	Kg/mu	138.5	141.5	142.9	144.9	140.7	142.2	143.6	145.2	143.8	144.7	145.5	146.0	146.5
	Decrease compared with check (%)	5.1	3.7	2.4	1.1	3.9	2.9	2.0	1.8	1.2	1.7	0.7	0.3	-

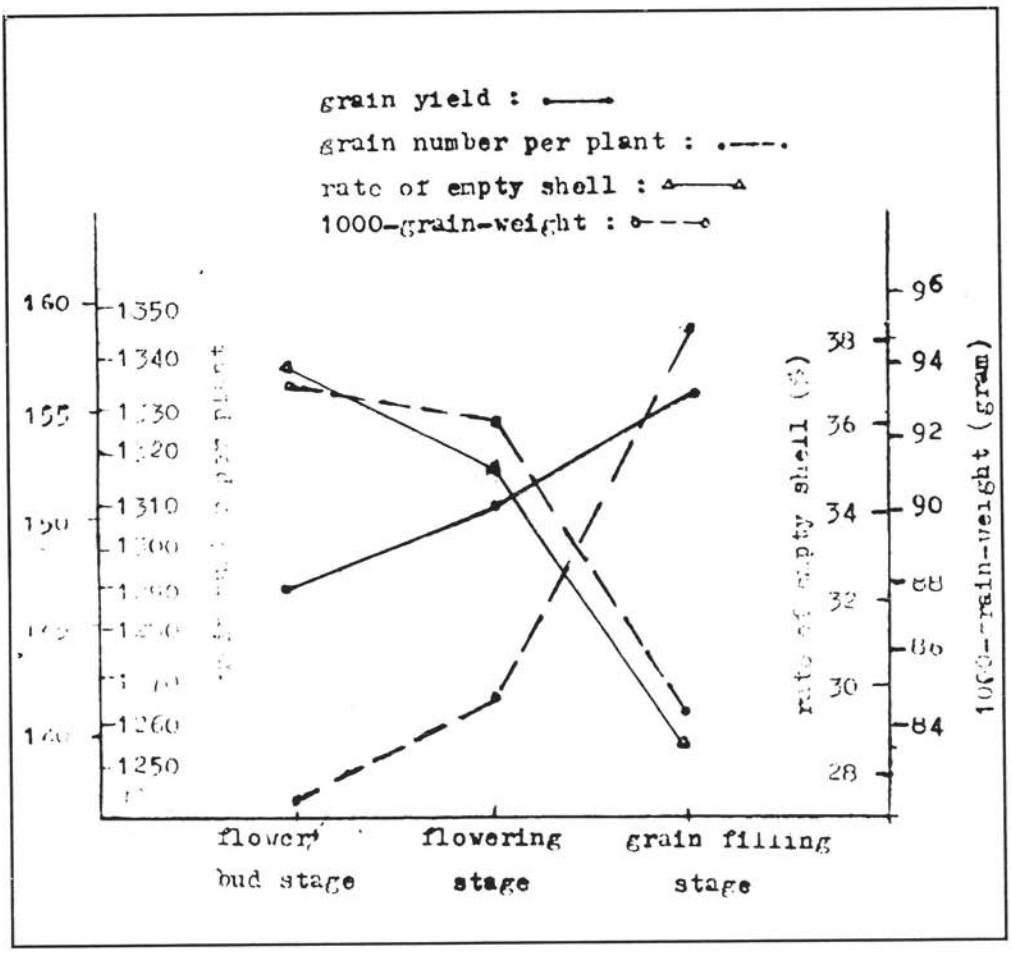

Figure 1. The effect of pruning away the total bracteal leaves at different stages on grain yield components

It was also proved by the results that the extent of grain yield reduction increased simultaneously with the increase of the number of the bracteal leaves removed. The date in Table 1 indicated obviously that the grain number per single plateau, the rate of empty shell, 1000-grain weight and grain yield changed relevantly as the increase of the pruned bracteal leaf. The reduction of the grain number per plateau, 1000-grain weight and grain yield and the increase of the rate of empty shell were in order of 100%>75%>50%>25% of bracteal leaves removed.

The effect of puning off bracteal leaves was the same for the oil-type variety and the confectionery one (Table 1), but the extent of the effect was lower in the former.

The effect of pruning away the bracteal leaves 100% on edible variety was more severe for the confectionery variety than for the oil-type one at the same stage. Comparing Table 1 with Table 2, which is mainly because of the difference of bracteal leaf area, actual data on bracteal leaf area of the two types of variety were illustrated in Table 3. Although there was no significant difference between the two ratios of the bracteal leaf

in the total leaf area of the two types of variety, thet bracteal leaf area of the confectionery variety (1342.70 square centimeters) was 2.8 times larger than that of the oil-type ones (470.11 square centimeters). The larger the bracteal leaf area was, the more photosynthetic products it made. And because the distance of transportation of organic substances was short, the effect on yield was relatively large.

Table 3. Bracteal leaf area of different types of variety

Leaf area	Confectionery (Beikui No.15)	Oil-type (Advanced worker)
Number of leaves	38	28
Leaf area (cm^2)	16254.23	9135.81
Number of bracteal leaves	61	53
Area of bracteal leaves (cm^2)	1342.47	470.11
Total leaf area (leaves and bracteal leaves) (cm^2)	17596.70	9650.92
Percentage of bracteal leaves area in total leaf area (%)	7.5	4.8

*leaf=lenght of leaf+width of leaf 0.701 (Anderson, 1977)

The variance analysis indicated that the ranges of reduction for the three treatments were different from that in the check when the total bracteal leaves were pruned during the flower bud stage and the flowering stage for both the confectionery and the oil-type variety, and when 75% of the bracteal leaves were pruned during the flower bud stage for the confectionery variety. The results of the t-test were that the t value of 5% was equal to 5.81 for the confectionery variety, while the t values of 5% were 6.03 and 5.90 for the total bracteal leaf prund during the flower bud stage and flowering stage; the t value of 5% was 3.46 for the oil-type variety, while the t value of 5% was 3.52 for the total bracteal leaves removed. The other treatments were not significant at the 5% level. This should not be ignored when considering the effect of the bracteal leaf on grain yield in sunflower.

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EFFET DES FEUILLES BRACTÉALES SUR LE RENDEMENT DU TOURNESOL

RÉSUMÉ

Les feuilles bractéales, la source la plus proche du pool des grains, augmentent la surface chlorophyllienne ainsi que l'efficacité du tournesol et leur élimination réduit le rendement en grain de 1,9à 7,6% pour une variété de bouche et de 1,8 à 5,1% pour une variété à haut rendement en huile. Exceptées les blessures mécaniques provoquées par l'élimination des feuilles, les effets de la destruction des feuilles bractéales sur le rendement en grain sont en accord avec les résultats de Pereita (1978) qui montrèrent que 5% du rendement en grain était assuré par les dix feuilles situées dans la partie basale de la tige de tournesol.

Des mesures devraient être prises pour sauvegarder et promouvoir la croissance des feuilles bractéales. La sélection pour la surface des feuilles bractéales et pour le gradient et la taille des fleurs devrait être également pris en compte dans les programmes de sélection. Selon Rytaeb A.N. la surface des feuilles bractéal s est un caractére quantitatif qui peut être choisi comme objectif de sélection et amélioré dans un programme de sélection.

EFECTO DE LAS HOJAS DE LAS BRACTEAS SOBRE EL RENDIMIENTO EN GRANO EN GIRASOL

RESUMEN

Las hojas bracteales, la fuente mas cercana al grano, incrementa el área fotosintetica y su eficiencia del girasol y su supresión reduce el rendimiento en grano en 1.9 a 7.6% en una variedad de boca y en 1.8 a 5.1% en una de alto aceite. Excepto por el dannno mecánico cuando la hoja bracteal es eliminada, los efectos de eliminación de la hoja bracteal en el rendimiento están de acuerdo con los resultados de Perera (1978) quien estableció que el 5% del rendimiento en grano fue aportado por las hojas localizadas en la parte basal del tallo. Debe ser tomadas medidas para promover a salvaguardar el crecimiento de la hoja bracteal. La selección para el área de la hoja bracteal y gradiente y tamannno del disco floral debe ser también llevado a cabo en programas de mejora de acuerdo con A.N. Rytaeb en el área de la hoja bracteal es un caracter cuantitativo que debe ser considerado como objetivo y mejorado en un programa de mejora de girasol.