Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi (9), 1-2 2000

A RESEARCH ON MORPHOGENETIC VARIABILITY OF ACCUMULATION OF OIL AND PROTEIN IN SOME SOYBEAN *(Glycine max* (L.) Merr.) CULTIVARS

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SUMMARY: This study was carried out to determine plant inferior variation in terms of accumulation of ail and protein and how position effect can change chemical of seed in some soybean cultivars (Williams, AP-350, A-3127 and Corsoy) under Ankara conditions in 1997. The samples were ensured from soybean cultivars reached to harvest maturity. These plants were divided to three parts and these parts were called as bottom, center and top. Besides, twelve pods per plant were broken from various portions of plant and it was regarded that each pod had content. In addition, it was determined that the protein content in pod declined from basal to tip three seeds. Three seeds were also described as tip, middle and basal of pod. Later, protein and oil content of the seeds in the different pods on the plant and at the various portions of pod were determined. Protein and oil ratio were determined at Department of Field Crops analysis lab, Faculty of Agriculture, University of Ankara. According to the results; it was observed that accumulation of oil and protein may vary position of pod on the plant, position of the seed in the pod in all cultivars. It was determined to decline oil content from bottom to the top, in contrast to increase protein while oil content increased in all cultivars.

Key Words: Soybean, oil, protein, variation.

BAZI SOYA *(Glycine max* (L.) Merr.) ÇEŞİTLERİNDE YAĞ VE PROTEİN BİRİKİMİNİN MORFOGENETİK VARYABİLİTESİ ÜZERİNE ARAŞTIRMA

ÖZET: *Bu çalışma, bazı soya çeşitlerinde (Williams, AP-350, A-3127 ve Corsoy) protein ve yağ birikimi bakımından bitki içi varyasyonu ve pozisyon etkisinin soya tohumunun kimyasal içeriğine ne şekilde etkide bulunduğunu saptamak amacıyla 1997 yılında Ankara koşullarında yürütülmüştür. Hasat olgunluğuna ulaşmış soya çeşitlerine ait örnek bitkiler üçe bölünmüş bu kısımlar sırasıyla dip, merkez ve üst olarak tanımlanmıştır. Aynı şekilde her bitkiden oniki bakla koparılmış üç tohuma sahip baklalardakı tohumlar bakladaki pozisyonuna göre dip, orta ve uç olarak isimlendirilmiştir Daha sonra çeşitli bitki kısımlarındaki tohumlar ile baklanın farklı kısımlarındaki tohumlarda yağ ve protein analizleri yapılmıştır. Araştırma sonuçlarına göre protein ve yağ birikiminin bitkideki bakla ve bakladaki tohum pozisyonuna göre değişebileceği gözlenmiştir. Her dört çeşitte de bitkinin dip kısmından uca doğru gidildikçe tohumların yağ içeriğinin azaldığı'buna karşılık protein oranının arttığı saptanmıştır. Ayrıca üç tohumlu baklaların dip kısmından ucuna doğru gidildikçe tohumların protein içeriğinin azaldığı, yağ oranın arttığı tespit edilmiştir.*

Anahtar Kelimeler: *Soya, yağ, protein, variation.*

INTRODUCTION

Soybean *(Glycine max* (L.) Merr.) is mainly cultivated for its seeds used commercially as human and stock food, and the extraction of oil. It is presently the world's most important grain legume in terms of total production and the greatest source of vegetable oil. Recently, totally 158.327 million tones/year soybean seeds have been produced in the world and it could be seen as the first among oil seed crops. (Anonymous, 1998 a). Production of soybeans in Turkey increased rapidly during 1982-1990 and it reached to 250.000 tones/year. However, it has declined to about 60.000 tones in the recent years (Anonymous, 1998 b). Unfortunately, the foreign trade of Turkey in soybeans and soybean products is small yet.

Seed oil content of soybean is a variatiel characteristic and is influenced by environment and climate, within range of 18-24 %. Protein content, of greater importance, is usually between 40 and 50 %. Therefore, soybean is a typical oil and protein crop. Protein content is inversely related to oil content but there are also some indications that high protein

content can be associated with lower seed yield. Besides, seed size and seed yield relate with protein and oil content in some plant species. High yielding plants consistently produce seed with higher oil content than seed from low yielding plants in the same planting of soybean (Lokumcu, 1998).

Plant inferior variation described as morphogenetic variability has been investigated in various plant species so far. There are many literatures related to the external factors (climate and soil factors) affecting chemical composition, but very few concerning the internal factors such as position of fruit in plant and place of seed inside of fruit. The objective of this study was also to determine plant interior variation in terms of oil and protein percentage and how position effect can change chemical structure of seed in some soybean cultivars.

MATERIAL AND METHODS

This research was carried out in randomized plot design with 3 replications at the experimental field of Agriculture Faculty. in the trial, the plot size was 8 m^2 (4x2m). The characteristics of experimental area were clay and loam, pH value was 7.96, lime was 4.5 %, humidity was 4.5 %, clay was 34.6 %, sand was 23.5 % and silt was 44.5 %. The main of monthly ram amount, moisture ratio and mean temperature (°C) values in the growing period are showed in Table 1. The place where the research was conducted reflected the typical characteristic of the climate conditions of Ankara. At this research, four soybean cultivars (Williams, A 3127, AP 350 and Corsoy) were used as the study material and selected to obtain a wide range in protein and oil content. The cultivars used as material have approximately same vegetation time and are very suitable for ecological conditions of Ankara. The seeds were sown with a distance 60 cm, 4 cm depth. 12 kg/da pure nitrogen was applied to plots before sowing as urea (45 % N) and disked in to the surface soil. After sowing 130 days later 10 plants were taken per plot and each plant was to divided to three parts equally according to the number of nodes producing seed. Three parts were described as top, center and bottom. in addition, three pods per plant were broken from various portions of plant. it was regarded that each pod had three seeds. These three seeds were also described as tip, middle, and basal of pod. Then random sample of 12 pods per plant from top, middle and bottom and 3 seeds per pod was immediately taken to the laboratory. Protein and oil content of seeds were determined.

For oil and protein analysis, 3 replicated samples were separated and their crude oil analysis was done in soxhelet (Machine/device).

All data were statistically analyzed by using analysis of variance and treatment means were compared using Duncan's multiple test (Düzgüneş, et al.1983).

Table 1. The climatic data of experimental area for 1997 and long term means

Months	Temperature (°C)		Relative Humidity (%)		Precipitation (mm)	
	1926-90	1997	1926-90	1997	1926-90	1997
January	-0.1	2.3	78.0	76.4	40.5	37.1
February	1.3	0.7	74.0	68.3	34.9	17.2
March	5.4	3.4	65.0	58.6	35.6	15.2
April	11.2	7.5	59.0	67.0	40.3	91.3
May	15.9	17.4	57.0	57.5	51.6	71.4
June	19.8	20.3	51.0	55.4	32.6	122.4
July	23.1	22.8	44.0	50.4	13.5	1.4
August	23.0	20.9	42.0	58.2	10.3	29.5
September	18.4	16.0	47.0	55.2	17.4	0.2
October	12.8	12.9	58.0	66.9	24.4	60.0
Npvember	7.3	7.3	70.0	73.5	30.9	36.9
December	2.3	3.7	78.0	76.9	45.6	65.5
Mean	11.6	11.26	60.25	63.6	Total: 377.6	Total: 548.1

RESULTS AND DISCUSSION

According to the results, while AP-350 comprised the highest mean protein ratio (35.35 %), Williams had the highest mean oil ratio (21.70 %) among the cultivars. The highest protein ratio was obtained from top pods of Williams (36.14 %) A-3127 (34.77 %), AP-350 (37.76 %) and Corsoy (35.96 %) and the highest oil ratio values were determined in bottom pods of Williams (24.94 %), A-3127 (22.58 %), AP-350 (22.23 %) and Corsoy (21.81 %) (Table 2) .

The data will be discussed under headings of position of the pod on the plant and position of the seed in the pod.

Position of the pod on the plant

The mean protein ratio was found within range of 32.77-36.14 %, 31.35-34.77 %, 34.02-37.76 % and 32.02-35.96 % in the seeds on the different position of Williams, A-3127, AP-350 and Corsoy respectively. in contrast, the mean oil ratio changed between 19.00-24.94 %, 19.22-22.58 %, 19.21-22.23 % and 19.12-21.81 % in Williams, A-3127, AP-350 and Corsoy respectively.

The seed in the top position on the plant was determined to have the highest protein and lowest protein content in ali cultivars. According to the analysis of variance related to protein content in the different portion of plant, while it was found to be statistically difference from the point of protein content in Williams, A-3127, AP-350 and Corsoy ($p < 0.05$). Furthermore, according to the analysis of variance related to oil content in the different portion of plant, there was statistically difference in terms of oil content in Williams, AP-350 and Corsoy ($p < 0.01$). It was also found to be difference in A-3127 ($p < 0.05$). The means of the cultivars related to protein and oil content were compared using Duncan's multiple range test (Table 2).

Table 2. Means of protein and oil ratio in the seeds on the different portion of plant of soybean cultivars

	Cultivars							
	Williams		A-3127		AP350		Corsoy	
Portion of Plant	Protein (%)	Oıl (%)	Protein (%)	Oıl (%)	Protein (%)	Oil (%)	Protein	Oıl (%)
Bottom	32.77 c*	24.94 a	31.35 c	22.58 a	34.02	22.23 a	32.02 b	21.81 a
Center	34.80 b	21.16 b	32.75 b	21.10 ab	34.27 b	20.87 a	33.95 ab	20.86 a
Top	36.14 a	19.00 c	34.77 a	19.22 b	37.76 a	19.21 b	35.96 a	19.12 b
Mean	34.57	21.70	32.96	20.97	35.35	20.77	33.98	20.60
LSD(5 %)	1.049	0.848	1.117	2.531	2.159	1.561	2.992	1.113

*)Mean values within a column followed by the different letters are significant at the 0.05 probability level .

Position of the seed in the pod

According to the seeds in the different portions of the pod, the mean protein ratio was found within range of 32.90-35.24 %, 32.43-37.05 %, 31.40-35.45 % and 32.81-35.77 % in Williams, A-3127, AP-350 and Corsoy respectively. in contrast, the mean oil ratio changed between 19.09-20.58 %, 18.14-22.72 %, 19.21-20.17 % and 19.26-20.02 % in Williams, A-3127, AP-350 and Corsoy respectively (Table 3).

The seed in the tip position in the pod was found to have the highest oil content in all cultivars. However, while these differences were statistically significant in A-3127), Williams and AP-350 ($p < 0.05$), no statistically an important difference was found in Corsoy. The seed m the basal position in the pod was determined to have the highest protein content in all cultivars. In terms of protein content statistically an important difference was found in A-3127, Corsoy, AP-350 and Williams ($p < 0.05$). The mean of cultivars related to protein and oil content were compared using Duncan's multiple range test (Table 3).

Table 3. Means of protein and oil ratio in the seeds in the different portion of pod of soybean cultivars

	Cultivars							
	Williams		A-3127		AP-350		Corsoy	
Seed Position in Pod	Protein (%)	Oil (%)	Protein (%)	Oil (%)	Protein (%)	Oil (%)	Protein (%)	Oil (%)
Basal	35.24 a*	19.09 b	37.05 a	18.14 c	35.45 a	19.21 b	35.77 a	19.80^{ns}
Middle	33.96 ab	19.73 ab	33.87 b	20.14 b	33.12 b	20.29 a	34.12 b	20.02
Tıp	32.90 b	20.58 a	32.43 b	22.72 a	31.40 c	20.17 a	32.81 c	19.26
Mean	34.03	19.80	34.45	20.33	33.32	19.89	34.23	19.69
LSD (5 %)	1.370	0.956	2.094	0.898	1.092	0.945	0.453	0.751

*)Mean values within a column followed by the different letters are significant at the 0.05probabılity level .

^{ns}) not significant

Environmental factors, especially temperature, during the period of seed development and maturation may show to affect both content and composition protein and oil in all plants.

The climate and soil conditions affect considerably accumulation of oil and protein m all plants. Piper and Morse (1975) indicated that analyses made of over 500 distinctive kinds of soybeans showed a range of from 12-28 % in the content of oil and 36-61 % in the content of protein on an air-dry basis. In addition, it can be seen differences in same plant in terms of oil and protein content. Moreover, effect of position create variations on chemical and physical structure of seed. Jellum and Marion (1966) reported that spadix position had no effect on palmitic acid and stearic acid content in maize, however, seeds of first spadix had more oleic acid and linoleic acid than seeds of second spadix.

When effect of seed position on fatty acids in sunflower head was investigated, it was determined that oleic acid content decreased gradually from side of head to center of head (Zimmerman et al. 1973). Robertson (1979) found that latitude and average temperature during the full-bloom to harvest stages of field-grown sunflower had no effect on oil content. Lambert et al. (1967), who examined effect of seed position on spadix in maize, found that seeds in middle spadix had the highest oil content. Turgut et al. (1996), stated that capsule position had little effect on palmitic and stearic acid and the highest oil ratio was obtained from middle capsules in sesame. It is considered that environmental factors such as light

intensity, temperature regime, precipitation and chemical content of soil affects protein and oil accumulation in seeds. The variations in oil and protein content may be due to environmental effects, growing techniques like plant density, sowing time, harvesting time, fertilization etc. and genetic factors.

In conclusion, the various portions of soybean cultivars used as material in this study showed big variations interms of oil and protein content in the study. it was observed that the effects of position create important variations on chemical content of soybean seeds. We hope that our data presented may be useful for analytical studies in the future.

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