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Effects of Haulm Cutting Time on Haulm and Pod Yield of Peanut

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Abstract: A two-year study was conducted to determine the optimum haulm cutting time for maximum hay and pod yield in 2001 and 2002. The experimental design was a Randomized Complete Block in a split plot arrangement with three replications. Two peanut cultivars, NC 7 and Com and a peanut line, 75/1073, were employed as main plots. Four haulm cutting times with one week interval starting from 17 Weeks after Planting (WAP) were employed as split plots. Haulm fresh and dry weight significantly varied among cultivars and cutting times. The peanut line 75/1073 had the highest haulm fresh and dry weights in both 2001 and 2002. The highest haulm fresh and dry weights were obtained from the cutting performed at 20 WAP in both years. Crude protein content of peanut haulm linearly decreased from 10.6% at 17 WAP to 8.1% at 20 WAP. The two or more seeded pod weight, one seeded pod weight, shelling percentage, number of pods/plant and seed weight decreased with the early haulm cuttings in both years. The highest pod yield was obtained when haulm cutting was performed at the digging time. The result of the current study showed that the best haulm cutting time was 2 or 3 days before digging if the aim was to obtain the highest pod yield. However, the cutting time at 17 WAP provided the highest crude protein content.

Key words: Peanut (*Arachis hypogaea*), haulm cutting, haulm yield, pod yield

INTRODUCTION

Peanut (*Arachis hypogaea* L.) cultivation is a major agricultural activity for the farmers of the eastern Mediterranean region of Turkey. Peanut is mainly grown for its seed but all parts of the plant are utilized. The peanut haulm (vines with leaves) is one of the most important peanut by-products used to supply feed to beef cattle in the region. In addition, peanut hay adds an extra income to small farmers. Peanut hay quality depends on cutting time, weather conditions and absence of foliar diseases. Peanut hay yield is affected by cultivar, level of disease and insect, time of digging, pre-harvest conditions and drying methods. Maximum dry matter yield of peanut haulm is reached before the optimum digging time for seed yield[1]. Nutritional value of the peanut haulm declines while the crop approaches to physiological maturity. Halevy and Hartzook[2] stated that phosphorus and nitrogen content of peanut haulm began to decline 37 and 64 days before harvest, respectively. The leaf/stem ratio also affects the hay quality since peanut leaf contain more than twice the nitrogen compared to either stem or root fractions. Currently, pesticide usage is rare due to the absence of peanut pests in the region. With the presence of peanut pests, use of certain pesticides restricts the utilization of peanut haulm as forage.

In the peanut production areas, peanut hay is an abundant source of legume hay[3-5]. Use of legume forages as supplement has been suggested as an alternative to using grains[6]. If peanut hay is properly harvested with minimal leaf shatter, it is comparable to good-quality grass hays in terms of nutrient content[7]. Legume forages supply nitrogen, which is an essential nutrient for most rumen microbes and minerals[8]. In addition, legume forages have readily degradable cell walls[9] which increase substrates available to cellulolytic microbes.

Peanut harvesting operations, consisted of field preparation, haulm cutting, digging, shaking and combining, are tended to mechanize in the region due to high labor cost. Haulm cutting is necessary to reduce the amount of foliage entering to the combine to increase separation efficiency. Since some peanut cultivars produce dense, heavy haulms; cutting the haulm should be performed before digging by using a cutter set to remove the top one-half. Haulm cutting is not applied in the case of hand harvest. In such a case, pods were removed by hand and the vegetative portion of the plant were gathered, dried and stored to use as fodder for livestock Peanut haulms are known to make high quality hay if they can be harvested at their maximum nutritional level. However, peanut pods are not ready to be lifted when peanut haulms are at their maximum nutrition level, pods are not ready to lift. However, early lifting severely reduces pod yield. The purpose of this study was to determine the best haulm cutting time for optimum hay and pod yield of peanut.

MATERIALS AND METHODS

The experiment was carried out at the Research Farm of Mustafa Kemal University, Hatay (36°15' N and 36°30' E) located in the Eastern Mediterranean region of Turkey, in 2001 and 2002. The soil at the experimental site is classified as Chromoxeret according to the USDA Soil Taxonomy[10] and as Vertisol by FAO/UNESCO[11] having high clay content, with 1.7% organic mater, 6% sand, 69% clay, 24% silt and pH 7.6. Based on soil analysis and local recommendations, fertilizer was applied prior to planting at a rate of 36-25-0 kg ha^{-1} NPK. Recommended practices were used for weed and insect control. Total annual precipitation in the site of study was 652 mm in 2001 and 714 mm in 2002. Mean air temperature was about 26°C at cropping period (May-October) in both years, while the mean relative humidity was around 52 and 54% during growing periods in 2001 and 2002, respectively.

Two widely grown peanut cultivars NC 7 and Com were selected for their high yield potential and a peanut line 71/1073 was selected for its higher foliage. The experimental design was a Randomized Complete Block in a split plot arrangement with three replications in both years. Peanut cultivars (NC 7, Com and 75/1073) were employed as main plot while haulm cutting times (week after planting, WAP) (17 WAP, 18 WAP, 19 WAP and 20 WAP) were employed as split plots. Seeds were planted at a rate of 5 seeds per m of row on 5 May 2001 and 9 May 2002. Plots consisted of four 6 m rows, planted 0.65 m apart. In both years, seed germination and plant emergence were enhanced by applying light sprinkler irrigation. Flood irrigation was applied every 20 days after emergence. Trifluralin was applied at the rate of 1200 g ha^{-1} pre-sowing to control annual weeds. After emergence, weeds were controlled with hoe or rotor-cultivator in each year.

The mean growing periods of the peanut cultivars used in this study were about 140 days from planting to harvest. A fixed harvest time was scheduled for both years of the study by adding 140 days to the planting dates. The four cuttings were set starting at 17, 18, 19 and 20 weeks after planting. At each harvest time, plants were cut with a sickle 10 cm above the soil surface. The fresh haulm samples of each plot were separately weighed and then dried at 55°C for 2 days to determine fresh haulm weight. The total N content of the peanut hay was assayed by a Kjeldahl method[12], modified by using a solution of boric acid (40 g L^{-1}) to receive free ammonia during distillation; a solution of 2 g L^{-1} of bromocresol green and 1 g L^{-1} of methyl red in ethanol as indicator and a standard acid solution (sulfuric acid) for titration.

Ten plants were harvested at maturity from the first and fourth rows of each plot for measuring number of pods/plant. Pod yield was estimated by harvesting 5 m of two central rows at maturity. Pods were classified into three groups; two or more seeded pods, one seeded pods and no seeded pods. While estimating the pod yield, pods containing no seed were excluded. Seed weight (g per 100 seed) was determined by counting 300 seeds from each yield sample and weighing the sample and dividing the weight by three.

Measured plant parameters data were subjected to analysis of variance using the General Linear Model (GLM) procedure in the Statistical Analysis System software package[13]. Means of measured plant parameters were compared by using Fisher's protected Least Significance Difference test with Type I error of 0.05. Simple correlations were obtained with the ANOVA procedure with the MANOVA option.

RESULTS AND DISCUSSION

Haulm fresh weight significantly varied among peanut cultivars (Table 1). The highest haulm fresh weight was obtained from the peanut line 75/1073 with 2.92 and 2.88 t ha^{-1} in 2001 and 2002, respectively. Peanut line 75/1073 was chosen for its higher foliage; whereas, NC 7 and Com were chosen for their high yield potential in the region. Peanut haulm fresh weight varies between 1 and 5 t ha^{-1}, depending on cultivar and environment[14,15]. In the present study, haulm fresh weights were within the limits of previously reported[14,15]. Peanut cultivar Com had the lowest haulm fresh weight with 2.10 t ha^{-1}in 2001 while NC 7 had the lowest haulm fresh weight with 1.90 t ha^{-1}in 2002. Like haulm fresh weight, haulm dry weight showed similar variations among peanut cultivars. The highest haulm dry weights were obtained from the peanut line 75/1073 with 0.81 and 0.71 t ha^{-1} in 2001 and 2002, respectively. Owing to the minor importance of peanut hay, there were a few studies conducted to determine haulm fresh and dry weights of cultivated peanut[14,15]. However, great attention has been given to the rhizome (perennial) peanut (*Arachis glabrata* Benth.) as a forage crop instead of common peanut (*Arachis hypogaea* L.)[16-21].

When harvesting time was in consideration, the haulm fresh and dry weights significantly varied among cutting times in both years (Table 2). The highest haulm fresh weight was obtained when the crop was harvested for its seed at 20 WAP in 2001 and 2002. Maximum haulm fresh and dry weights of peanut haulm were reached when

Table 1: Haulm Fresh Weight (HFW), Haulm Dry Weight (HDW), Two or More Seeded Pod Weight (TMSPW), One Seeded Pod Weight (OSPW), Shelling Percentage (SP), Number of Pods/Plant (NPP), Seed Weight (SW) and Pod Yield (PY) according to the cultivars

	HFW (t ha^{-1})		HDW (t ha^{-1})		TMSPW (t ha^{-1})		OSPW (t ha^{-1})		SP		NPP		SW (g)		PY (t ha^{-1})	
Cultivar	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
NC 7	2.27	1.90	0.63	0.54	2.28	2.30	0.92	1.00	65.36	65.64	55.43	51.86	65.83	68.35	3.20	3.30
Com	2.10	2.36	0.56	0.62	2.04	2.03	0.94	1.01	66.17	65.47	52.83	52.83	64.30	64.48	2.98	3.03
75/1073	2.92	2.88	0.81	0.71	2.01	2.00	1.21	1.12	64.41	63.42	58.46	51.09	63.56	64.39	3.22	3.15
LSD (0.05)	0.16	0.28	0.09	0.09	NS	NS	0.26	0.28	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Haulm Fresh Weight (HFW), Haulm Dry Weight (HDW), Two or More Seeded Pod Weight (TMSPW), One Seeded Pod Weight (OSPW), Shelling Percentage (SP), Number of Pods/Plant (NPP), Seed Weight (SW) and Pod Yield (PY) according to cutting times

	HFW (t ha^{-1})		HDW (t ha^{-1})		TMSPW (t ha^{-1})		OSPW (t ha^{-1})		SP		NPP		SW (g)		PY (t ha^{-1})	
Cutting time	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
17 WAP	2.34	2.19	0.57	0.58	1.22	1.28	0.71	0.77	58.37	56.54	43.84	43.32	52.51	52.44	1.93	2.04
18 WAP	2.39	2.46	0.66	0.61	1.60	1.59	0.85	0.90	66.74	69.02	56.08	51.22	56.11	56.16	2.45	2.49
19 WAP	2.44	2.36	0.70	0.62	2.63	2.64	1.13	1.15	68.33	67.72	54.76	48.30	64.60	66.42	3.76	3.80
20 WAP	2.53	2.51	0.71	0.69	2.98	2.93	1.41	1.39	67.82	66.08	67.63	64.89	85.09	87.93	4.39	4.32
LSD (0.05)	0.19	0.32	0.10	0.11	0.68	0.70	0.30	0.32	3.23	3.85	14.39	12.31	9.56	6.80	0.84	0.87

Table 3: Correlation coefficients of investigated plant parameters of peanut

	HFW	HDW	TMSPW	OSPW	PY	SP	SW	NPP
HDW	0.63**							
TMSPW	0.06	0.25*						
OSPW	0.32**	0.29*	0.64**					
PY	0.15	0.29*	0.97**	0.81**				
SP	0.04	0.19	0.47**	0.31**	0.46**			
SW	0.04	0.02	0.57**	0.51**	0.60**	0.35**		
NPP	0.18	0.32**	0.54**	0.55**	0.59**	0.09	0.42**	
CPC	-0.09	-0.23	-0.60**	-0.55**	-0.53**	-0.15	-0.66**	-0.50**

*,** Correlation coefficient (r) is significant at the 0.05 and 0.01 probability level, respectively; HFW: Haulm Fresh Weight, HDW: Haulm Dry Weight, TMSPW: Two or More Seeded Pod Weight, OSPW: One Seeded Pod Weight, PY: Pod Yield, SP: Shelling Percentage, SW: Seed Weight, NPP: Pod Number/plant, CPC: Crude Protein Content

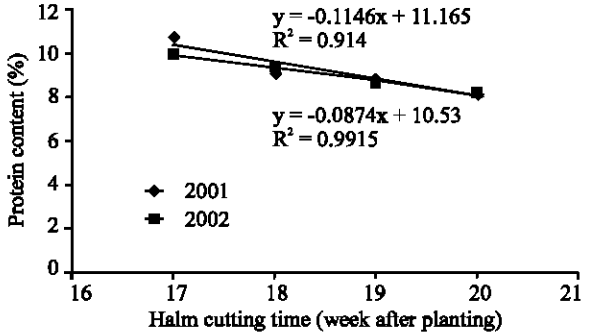

Fig. 1: Crude protein content of peanut haulm at four different cutting times

the crop was at the optimum lifting time for seed yield. Wright *et al.*[1] reported similar results. There was no foliar disease to reduce hay quantity and quality during both years of the study; therefore, no chemical was used. In the present study, haulm fresh and dry weights were negatively correlated with the crude protein content of peanut haulm; however, the correlation coefficients were not high (Table 3). The highest and the lowest crude protein contents were obtained from the cuttings performed at 17 and 20 WAP, respectively in both years (Fig. 1). Crude protein content of peanut haulm linearly decreased with the delaying of cutting time (Fig. 1). A gradual decrease in crude protein content from 19.7% at 120 days after planting to 11.8% at 160 days after planting was reported by Subrahmanyam[22]. Crude protein content of peanut haulm is an important factor for hay quality. In the current study, crude protein contents were found to be within the limits of the previously reported studies[23-26].

Two or more seeded pod weight significantly varied among peanut cultivars. The ratio of two ore more seeded pod is an important marked criterion (Table 1). It was found that harvesting peanut 2 weeks before digging time significantly reduced both the two or more seeded pod weight and one seeded pod weight (Table 2). Number of pods/plant did not significantly vary among peanut cultivars and line (Table 1). The highest number of pods/plant was obtained from peanut line 75/1073 and Com in 2001 and 2002, respectively. Number of pods/plant significantly correlated with pod yield (r=0.59), two or more seeded pod weight (r=0.54), one seeded pod weight (r=0.55) and 100 seed weight (r=0.42) (Table 3). Haulm cutting time significantly affected the number of pods/plant in 2001 and 2002 (Table 2). The lowest number of pods/plant was obtained from the cutting performed at 17 WAP and the highest number of pods/plant was obtained with the cuttings performed at 20 WAP in both years.

Shelling percentage did not varied among peanut cultivars; however shelling percentage significantly varied among cutting times. In the both years of the study, the lowest shelling percentage was obtained from the cutting performed at 17 WAP. Shelling percentage significantly correlated with seed yield (r=0.46). The

hundred seed weights did not vary among peanut cultivars since NC 7, Com and 75/1073 are large seeded Virginia type peanut cultivars. In both years, early haulm cuttings significantly reduced the hundred seed weight. The hundred seed weight significantly correlated with pod yield (r=0.60). Haulm cuttings earlier than digging maturity significantly decreased both number of pods/plant and seed weight.

Pod yield did not significantly vary among peanut cultivars in both years. Cultivar NC 7 and Com are widely grown cultivars in the region whereas cultivars 75/1073 is an introduction material commercially not grown. Pod yields varied between 2.98 and 3.22 t ha^{-1} in 2001 and between 3.03 and 3.30 t ha^{-1} in 2002. The peanut line 75/1073 and cultivar NC 7 had the highest pod yields in 2001 and 2002, respectively.

Haulm cutting time significantly affected the pod yield. As expected, the lowest pod yield was obtained from the cutting performed at 17 WAP with 1.93 kg ha^{-1} in 2001 and 2.04 t ha^{-1} in 2002. When haulm cutting was carried out 1 week before digging, corresponding to 19 WAP, pod yield did not significantly decrease in both years; whereas, pod yield significantly decreased when cutting was performed in 2 and 3 weeks before digging, corresponding to 18 and 19 WAP, respectively. Subrahmanyam[22] obtained the highest pod yield when digging was done within 20 WAP. Like pod yield, fresh and dry biomass weight significantly varied among cutting times. Consequently, the best haulm cutting time for hay and pod yield was 2 or 3 days before digging. However, crude protein content of peanut hay reduces as cutting time was delayed (Fig. 1). In terms of crude protein content, however, the first cutting (17 WAP) is more proper than the other cutting times. Haulm cuttings earlier than this time severely decreased pod yield. Pod yield decrease in the early cuttings was mainly resulted from the decrease in the number of pods/plant and seed weight. There is a trend to shift from hand harvest to mechanical harvest due to the high labor cost in Turkey. In case of mechanical harvest, haulm cutting eases mechanical harvest if performed properly.

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