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Effect of plant density and weeding frequency on reducing competitiveness of weeds and improving peanut yield

Ali Shirinpour Valadi*

Islamic Azad University, Rasht Branch, Rasht, Iran

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Abstract

In order to study on the effect of plant density and weeding time on the growth and yield of peanut, a trial conducted as factorial with 2 factors including; plant density in 3 levels (a_1: 60000, a_2: 80000 and a_3: 100000 plant/ha) and weeding time in 4 levels (No-weeding, weeding one time at 2-4-leaf stage, weeding two times at 2-4 and 6-8-leaf stage, and weeding three times at 2-4 leaf, 6-8 leaf and crop canopy closure time of peanut) using randomized complete block design in 4 replications in the Kiashahr port, Guilan province. Weed dry weight, peanut cumulative dry weight, pod yield, ripen pod number on plant, weight of ripen pod, shoot yield, kernel production percentage and 100 seed weight studied as traits in the experiment. Analysis of variance showed that plant density had significant effect on the most characteristics and increasing in density caused to improving of traits. Also, results revealed that weeding time influenced the traits significantly. Based on mean comparison, 80000 and 100000 plants/ha densities were more effective than 60000 plants/ha on some traits including: peanut cumulative dry weight, pod yield, ripen pod number on plant, shoot yield, 100 seed weight. In addition, 2 and 3 weeding controlled all weeds in the peanut field better than other treatments. Based on results can explain that growth and yield of peanut can be improved under proper plant density and weeding time. The best treatment was 80000 plants/ha with 2 weeding to increase yield of peanut.

* **Corresponding Author:** Ali Shirinpour Valadi ✉ shirinpourvaladi@gmail.com

Introduction

The yield of crops mostly depends upon the number, size and adjacency of weeds after the emergence of the crops. Weeds viability is also influenced by the number, size and adjacency of the crops. Therefore, any agronomic or managerial operation that disrupts competition balance for the crops and against the weeds is useful to the crops and harmful to the weeds. An example of these agronomic techniques is increasing plant density per unit area of the land. In other words, intensive planting and creating predominant crop coverage can equip peanut plants with a competitive advantage in their competition with weeds (Anis *et al.,* 2001; Chin Choy *et al.*, 1982). The literatures show that using intensive planting pattern in peanut fields can reduce the population of the weeds by 45% and can increase pod yield of the plants by 39% (Gardner and Auma 1989; Mixon 1989; Wells *et al.*, 1991). In fact, peanut is an indeterminate crop and can readily respond to the sowing density by changing its number of pods per plant which is regarded as a critical point in weeds management (Raghvani *et al.*, 1984). However, it should be remembered that higher number of plants per unit area results in lower yield of peanut per plant owing to inter-plant competition but it brings about higher radiation absorption by canopy which, eventually, results in higher pod yield (Flohr *et al.*, 1990). On the other hand, at optimum planting density more assimilates are mobilized to grains owing to more appropriate branching pattern of peanuts and so, the coefficient of partitioning is increased (Gardner and Auma 1989; Raghvani *et al.*, 1984). It has been shown that there is often a sigmoid relationship between the yield of the crops and the population of the competing weeds. It suggests that as the population of weeds is increased, the yield of the crops is decreased more severely (Chin Choy *et al.*, 1982; Jaaffar and Gardner 1988). Therefore, it can be said that there is a close relationship between optimum crop yield and the availability of nutrients and radiation and that the improper management depriving the crops from these resources can result in increased growth of weeds and their attack to these resources (Bunting *et al.*, 1985; Jaaffar and Gardner 1988; Sultan *et al.*, 2001). Studies on crops reveal that weeds management at specific stages of their growth cycle has the greatest impact on the yield and yield components of the crops. In such crops as soybean and peanut, it is only necessary to control weeds until certain stages of their growth cycle because hereafter, the volume of the plants increases and they can compete with weeds (Flohr *et al.*, 1990; Jaaffar and Gardner 1988; Mixon 1989; Raghvani *et al.*, 1984; Wells *et al.*, 1991). In other words, after entering the phase of linear dry matter increase, crops can readily compete with most weeds (Chin Choy *et al.*, 1982; Sultan *et al.*, 2001). Moreover, the higher relative capacity of these crops in the uptake of mineral nutrients from soil equips them with the capability of severely limiting the growth of the weeds (Jaaffar and Gardner 1988; Wells *et al.*, 1991). Another important issue in improving the competitiveness of crops, particularly peanut, is the weeding time which can increase the yield of peanut by influence the earlier formation of the pods and their higher filling rate. In fact, by on-time management of weeds, especially before the formation of peg and pods it can be expected to increase the yield of peanut per unit area because decreased competitiveness of weeds at these stages results in higher partitioning of assimilates to growing pods given the fact that crop growth rate, assimilate partitioning to pods, and effective pods filling period are the most important factors that influence the harvest index of peanut (Chin Choy *et al.*, 1982; Flohr *et al.*, 1990; Gardner and Auma 1989; Sultan *et al.*, 2001). Plant density and weeds are two important parameters that cause to decrease of peanut yield. Determination of the suitable plant density and the best weeding date and frequency can help to peanut farmers to achieve economic yield. Therefore, the present study was aimed at examining the effect of plant density and weeding frequency on reducing the competitiveness of weeds as well as on improving the yield of peanut.

Materials and methods

The present study was carried out in Kiashahr port (Long. 49°57' E., Lat. of 37°36' N., Alt. of -16.2 m), Guilan province, Iran.

Experimental Material and Treatments

The study was a factorial experiment on the basis of a Randomized Complete Block Design with four replications in which the first factor was plant density at three levels of 60 000, 80 000 and 100 000 plants ha^{-1} and the second factor was weeding frequency at four levels including: no-weeding, weeding one time at 2-4-leaf stage, weeding two times at 2-4 and 6-8-leaf stage, and weeding three times at 2-4 leaf, 6-8 leaf and crop canopy closure time of peanut. The intended densities were obtained by using constant and 40-cm row spacing which had been determined in the previous studies on determining row spacing of peanut. So, the planting patterns used for the densities of 60 000, 80 000 and 100 000 plants ha^{-1} were 40×40, 40×31 and 40×25 cm. These stages are regarded as the critical times of peanut plants. The seedbed preparation was initiated with the plowing in March followed by breaking of soil aggregates with rotavator. Then, the experimental plots with the dimensions of 5×5 m and the spacing of 80 cm were created. The replications were spaced 1 m apart. The seeds were sterilized by Tiram fungicide (2:1000) before sowing. The peanuts were sown under rain-fed conditions. The studied cultivar was NC_2 which is the locally prevailing cultivar. The seeds were sown by hand at the depth of 4 cm on May 10 and 11, 2007. Based on soil chemical analysis, the farm was treated with 100 kg ha^{-1} triple superphosphate, 60 kg ha^{-1} urea and 15 kg ha^{-1} potassium sulfate before sowing. At flowering time, about 80 kg ha^{-1} gypsum was added to all plots. In addition, at the initiation of pods underground growth, the shoots were sprayed with chelated-Zn (2:1000).

Measured traits

The studied traits included weeds dry weight at the first, second and third weeding, the variations of peanut dry weight during growing season, pod yield, shoot yield, 100-seed weight and kernelling percentage. The collected data were statistically analyzed by SAS and MSTATC software and the graphs were drawn by MS-Excel. The simple analysis of variance of the data was carried out in the form a factorial experiment on the basis of a Randomized Complete Block Design with four replications. The means were compared by LSD method at 5% probability level using SAS software.

Results and discussion

Accumulated dry weight of peanut plants

Fig. 1 is the curve of the Cumulative of peanut canopy dry matter at different plant densities. As can be seen in this figure, plant densities did not have significant differences in the accumulation of dry matter up to about 70 days after sowing (DAS), while after 80 DAS the difference among plant densities in accumulated dry weight was increased and the highest accumulated dry weight was observed at 100 000 plants ha^{-1}. It seems that the main reason for this increase was higher number of plants per unit area. In addition, the accumulation of dry matter was relatively high at 80 000 plants ha^{-1}, too; however, the lowest dry matter was produced at the density of 60 000 plants ha^{-1}. Since peanut plants did not cover the spacing between the rows at 60 000 plants ha^{-1}, the lower dry matter produced at the density can be related to the imperfect absorption of solar radiation by the canopy. After 80 DAS, the pattern of dry matter production considerably changed in all treatments, so that the dry matter produced at 60 000 plants ha^{-1} was lower than that produced at the densities of 80 000 and 100 000 plants ha^{-1}. The pattern of dry matter production was rather similar at 80 000 and 100 000 plants ha^{-1} and even, they were identical after 110 DAS (Fig. 1). Weeding frequency, too, had various impacts on the accumulation of dry matter in peanut plants. The pattern of dry matter production in canopy was not different between no-weeding and weeding one time conditions (Fig. 2) suggesting that weeding one time at 2-4-leaf stage of peanuts cannot increase the competitiveness of the plants for controlling the growth of the weeds, while weeding two and three times significantly increased dry matter accumulation in canopy. It should be noted that after the second weeding, the accumulation of dry matter in plants was significantly increased, but the increase in this trait caused by the third weeding was not significant. It appears that weeding two times at 6-8-leaf stage can significantly increase the competitiveness of peanut plants in their encounter with the weeds because when peanuts reach to 6-8-leaf stage, the environmental conditions, especially temperature, soil moisture and solar radiation, are suitable enough to make it possible for the plants to grow quickly and fill inter-row spacing.

Table 1. ANOVA of effect of planting density and weeding frequency on weeds dry matter.

		First weeding time	Second weeding time	Third weeding time
Sov	Df	Mean square		
Rep	3	40.34	21.49	290.33
Planting density (a)	2	37.61 ^{ns}	5118.75**	18446.59**
Weeding frequency (b)	3	29.71 ^{ns}	772.51**	1708.11**
Ab	6	15.70 ^{ns}	72.03 ^{ns}	950.25**
Error	33	36.62	42.79	85.28
Cv(%)		10.77	11.45	14.75

** and ^{ns}: significant at 1% and non-significant, respectively.

Table 2. Mean comparison of weeds dry weights in different planting density and weeding frequency.

	weeds dry weights in 1st time weeding (g)	weeds dry weights in 2ndtime weeding (g)	weeds dry weights in 3rd time weeding(g)
Planting density			
60 000 plant ha^{-1}	55.37	77.75	101.67
80 000 plant ha^{-1}	55.17	47.75	45.85
100 000 plant ha^{-1}	57.92	45.87	40.27
LSD (5%)	4.35	4.70	6.64
Weeding frequency			
Without weeding	56.60	59.43	59.70
One time weeding	57.26	62.40	74.10
Two times weeding	56.93	61.43	69.46
Three times weeding	53.83	45.23	59.70
LSD (5%)	5.02	5.43	7.67

Weeds dry weight

Analysis of variance of the effect of plant density and weeding frequency on weeds dry weight are shown in Table 1. Based on table 1, plant density had no significant effect on weeds dry weight at the first weeding time, i.e. the number of seeds sown per unit area does not play a significant role in managing the weeds because peanut seeds germinate slowly in field conditions and their seedlings emerge in about 10-14 days, whereas at the same time the seeds of most weeds, particularly the weeds that can germinate at low temperatures, emerge among the seeds of peanuts and establish more quickly than the peanuts. The effect of plant density was significant on weeds dry weight at the second weeding time. In other words, after the first weeding at 2-4-leaf stage, the conditions were probably changed in favor of peanuts so that they could use the environmental resources for their better establishment. In addition, weeds dry weight at the peanut densities of 80 000 and 100 000 plants ha^{-1} showed significant difference with that under the density of 60 000 plants ha^{-1}, but the difference in weeds dry weight between the peanut densities of 80 000 and 100 000 plants ha^{-1} was not statistically significant. The effect of weeding time was significant on the accumulation of weeds dry weight, too. It means that weeding at two stages of 2-4-leaf and 6-8-leaf stage can effectively control the weeds in peanut fields because after the first weeding, most weeds re-grow and since it is concurrent with the initiation of the increase in the number of leaves of peanuts, leaf area index of peanut canopies would appropriately increase if the weeding is re-practiced at 6-8-leaf stage. As a result, the production of assimilates by peanut canopies would be significantly increased leading to their better competition with the weeds. The interaction between plant density and weeding frequency was not significant at the second weeding time. In other words, at a given plant density, weeding frequency did not have significant impacts on weeds dry weight and/or their growth. At the third weeding time, plant density significantly influenced weeds dry weight. The highest weeds dry weight was observed at the density of 60 000 plants ha^{-1} which could be associated with the lower number of the plants per unit area; whereas the increase in the density to 80 000 and 100 000 plants ha^{-1} resulted in significantly lower weeds dry weight. It should be noted that the densities of 80 000 and 100 000 plants ha^{-1} had similar effects on controlling the growth of the weeds. The effect of weeding frequency was significant on weeds dry weight, too, implying that weeding at two times could effectively control the growth of the weeds inside the plant coverage because after the second weeding at 6-8-leaf stage, the peanuts had the maximum capacity to use environmental resources and furthermore, the uptake of minerals from soil by plants was increased with more penetration of the roots given the fact that the roots of this plant rapidly distribute in soil until 8-leaf stage. In addition, N fixation groups are formed in the roots of peanuts at this stage and the initiation of N fixation can be a very important parameter in the superior growth of peanuts as compared to the weeds. The interaction among plant density, weeding frequency and the time of the third weeding was significant too. In other words, weeding frequency can be adjusted by suitable plant density because, as can be seen in Table 4-2, the growth of the weeds inside peanut plants cover can be controlled by increasing plant density and reducing weeding frequency, i.e. since peanuts can compete with weeds only after passing through certain growth stages, if the peanut fields are weeded at appropriate time and the plant density is so selected that allow plants to better use environmental factor, then the growth of weeds inside peanut crop cover can be decreased.

Table 3. ANOVA for effect of planting density and weeding frequency on peanut yield and yield components.

Sov	df	Pod yield	Shoot yield	Kernelling (%)	100-seed weight
		Mean square			
Rep	3	25509.12	34815.132	12.21	2.84
Planting density (a)	2	2021555.24**	5371857.75**	43.84*	5.65*
Weeding frequency (b)	3	21866239.26**	37289264.29**	156.97**	27.58**
Ab	6	702109.21**	815775.77**	8158^{ns}	0.70^{ns}
Error	33	38730.19	154326.33	7.68	2.35
Cv(%)	-	6.12	8.63	4.01	2.10

Pod yield

Plant density significantly influenced peanut pod yield. In other words, peanut pod yield was affected by plant density so that the highest pod yield was obtained under the density of 100 000 plants ha^{-1}. However, the pod yield at this density had no statistically significant difference with that at 80 000 plants ha^{-1}. Since the studied cultivar was a Virginian large-seed cultivar for which the best sowing density is recommended as 65 000-75 000 plants ha^{-1}, it was observed that further increase in plant density did not result in considerable increase in pod yield. The reason for higher pod yield at the density of 80 000 plants ha^{-1} was higher number of mature pods and also, longer effective underground pod filling period, while at the density of 100 000 plants ha^{-1}, peanut plants were taller owing to greater competition between peanut plants which could have played a role in reducing the number of underground pods. Weeding time, too, had significant influence on peanut pod yield and the highest pod yield was obtained with weeding two and three times during peanut growth period. However, the pod yield under weeding two times had no statistically significant difference with that under weeding three times. It seems that since peanut plants have the competition capacity with weeds after the establishment and as the studies show, if the weeds are controlled during 14-70 DAS, peanut plants can successfully compete with weeds by their transverse development through bearing stem branches. It should be mentioned that pod yield under weeding once was similar to that under no-weeding conditions. The severe loss of pod yield under no-weeding and weeding at 2-4-leaf stage can be related to the fact that most weeds in peanut fields grow and compete with the crop during early growing season if the climatic conditions are appropriate as the study on the number and species of the weeds reveal. Weeds would heavily compete with peanut plants for the uptake of water and nutrients. This competition, particularly during pods underground filling, imposes inadequate uptake of elements such as Ca resulting in the severe loss of pod yield given that peanut pods uptake most of the elements required for their growth directly from the soil. The interaction between plant density and weeding frequency was statistically significant for peanut pod yield. In other words, peanut pod yield was influenced by the plant density and weeding frequency. The lowest pod yield at all densities was observed under no-weeding conditions while the highest pod yield was obtained at the density of 100 000 plants ha^{-1} with weeding frequency of three. At the density of 60 000 plants ha^{-1}, when weeding frequency was increased from one to two times, peanut pod yield was increased too and this ascending pattern continued until the weeding frequency of 3, so that the highest peanut pod yield was obtained at the density of 60 000 plants ha^{-1} with three times weeding. It seems that the low number of plants per unit area and the relatively long duration for the establishment and initiation of rapid plants growth at early growing season caused peanut plants not to have the power to compete with the weeds, particularly weeding for one time. At the density of 80 000 plants ha^{-1}, weeding 2-3 times significantly increased peanut pod yield which was higher than that at the density of 60 000 plants ha^{-1} with the weeding three times. At the density of 100 000 plants ha^{-1}, the increase in weeding frequency to two times significantly increased peanut pod yield. But, it should be taken into consideration that the increase in weeding frequency to three times did not increase pod yield at 100 000 plants ha^{-1} considerably. The increase in plant number per unit area can be an important factor in improving the competitiveness of peanuts. Under these conditions, the frequency of weeding can be decreased in peanut fields.

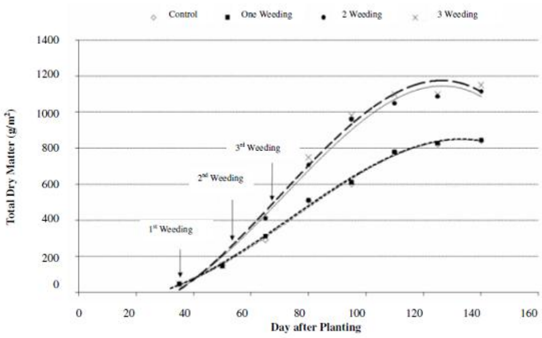

Fig. 1. Cumulative dry matter changes of peanut in different plant densities.

TDM (control) = 1.98907/[1+ 0.01610 exp(0.00010281x)] $R^2 = 0.98$

TDM (1 weeding) = 1.93907/[1+ 0.01819 exp(0.00011401x)] $R^2 = 0.98$

TDM (2 weeding) = 1.84139 /[1+ 0.05878 exp(0.00020577x)] $R^2 = 0.95$

TDM (3 weeding) = 1.69129 /[1+ 0.07272 exp(0.00031577x)] $R^2 = 0.95$.

Shoot yield

Based on Table 3, the effect of plant density was significant on peanut shoot yield so that shoot yield was increased with the plant density and that the highest shoot yield was obtained at 100 000 plants ha^{-1}. It seems that the great number of the peanut plants per unit area at the density of 100 000 plants ha^{-1} allowed them to cover the soil surface more quickly and to use the radiation more efficiently. In addition, since peanut plants cover inter-row spacing more quickly at this density, the photo-oxidation of hormone auxin was less likely to happen. Therefore, the increased concentration of this hormone around terminal stem regions attracted nutrients and hormones like cytokinin which is involved in cellular regulation. Consequently, the growth of lateral shoots and the production of initial and secondary branches of peanuts were inhibited. The effect of weeding frequency, too, was significant on shoot yield. The increase in weeding frequency increased peanut shoot yield, while the lowest shoot yield under no-weeding was caused by faster establishment of weeds than peanuts. The highest shoot yield was observed under weeding frequency of three. Since after weeding at two stages, peanut plants were well established, they were competitive enough to control the weeds resulting in the better growth of peanuts by absorbing more radiation and using other growth-affecting factors. The interaction between plant density and weeding frequency was significant for shoot yield, too. In other words, shoot yield varied significantly with the changes in plant density and weeding frequency so that the highest shoot yield was observed at the weeding frequency of three and at the densities of 80 000 and 100 000 plants ha^{-1}. It should be noted that the increase in shoot yield at the densities of 60 000 and 80 000 plants ha^{-1} was considerable with the increase in weeding frequency from two to three, whereas the shoot yield at 100 000 plants ha^{-1} did not significantly change with the increase in weeding frequency from two to three. It appears that the great number of plants per unit area at the density of 100 000 plants ha^{-1} was so that when the field was weeded at two stages, the peanuts were able to control the weeds, while it was not the case at the densities of 60 000 and 80 000 plants ha^{-1}. Therefore, it can be said that since the competitiveness of the peanuts increased more lately at the densities of 60 000 and 80 000 plants ha^{-1}, so it is necessary to weed the field at three stages to improve shoot yield. The other point to remember is that at 60 000 plants ha^{-1} density, the increase in weeding frequency from one to two did not significantly change peanut shoot yield which can be related to delayed establishment of peanuts at field conditions.

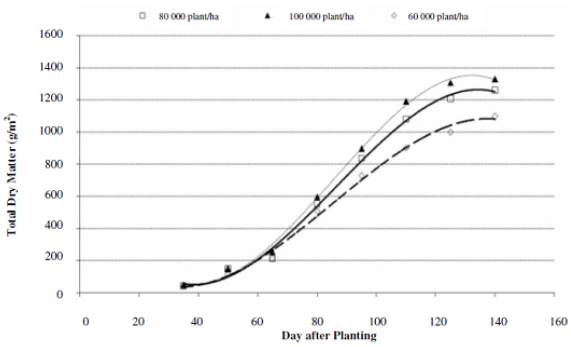

Fig. 2. Cumulative dry matter changes of peanut in different weeding times.

TDM (60000) = 1.1249/[1+ 0.09787 exp(0.00039066x)] $R^2 = 0.96$

TDM (80000) = 1.1712/[1+ 0.09855 exp(0.00040514x)] $R^2 = 0.98$

TDM (100000) = 0.75681/[1+ 0.11560 exp(0.00044576x)] R^2=0.97.

Kernelling percentage

Analysis of variance of the effect of weeding time and plant density on kernelling percentage is shown at Table 3. As can be seen, plant density significantly influenced kernelling percentage so that it was increased with the plant density. But, there was no significant difference in kernelling percentage between the densities of 80 000 and 100 000 plants ha^{-1}. The lower kernelling percentage at the density 60 000 plants ha^{-1} was seemingly related to the lower partitioning of assimilates to the growing pods and lower seed weight as compared to the pod weight. In other words, the increased formation of flowers in plants at the density of 60 000 plants ha^{-1} and/or more transverse development of the plants and the production of initial and secondary branches at this density resulted in mobilization of more assimilates towards the shoots of peanut plants and the decrease in kernelling percentage. The effect of weeding frequency was significant on peanut kernelling percentage, too. The highest kernelling percentage was obtained by weeding three times, while the lowest one was observed in no-weeding and weeding one time. It appears that by reducing competitiveness of the weeds and increasing the absorption capacity of peanut plants for their better establishment in the field, the increase in weeding frequency allowed the plants to increase their effective assimilation, pod filling and as a result, kernelling percentage. The interaction between plant density and weeding frequency revealed that the highest kernelling percentage was obtained at the densities of 80 000 and 100 000 plants ha^{-1} with weeding two and three times. However, the difference in kernelling percentage between these two densities and the weeding frequencies of two and three was not statistically significant, i.e. weeding two times at the densities of 80 000 and 100 000 plants ha^{-1} resulted in about 71% higher kernelling percentage because peanuts acquired enough power to compete with weeds on the radiation absorption and nutrients uptake after weeding at two stages. In addition, better development of the plants in inter-row spacing paved the way for better penetration of pegs into the soil. Consequently, it is observed that the kernelling percentage was similar among the treatments. At the same time, kernelling percentage at the density of 60 000 plants ha^{-1} was slightly increased with the weeding frequencies of two and three times probably because of the lower number of plants per unit area for the competition with the weeds which re-emerged in the field after weeding at three stages.

100-seed weight

The results of analysis of variance for the effect of plant density and weeding frequency on peanut 100-seed weight are presented in Table 3 according to which they significantly affected it. As the density was increased from 60 000 to 80 000 plants ha^{-1}, 100-seed weight was increased and the difference in this trait between the densities of 60 000 and 80 000 plants ha^{-1} was statistically significant. In fact, the highest 100-seed weight was obtained at the density of 80 000 plants ha^{-1}. Since the highest 100-seed weight is obtained when the peanut plants put the highest pressure on soil fertility by the uptake of nutrients, it can be concluded that the increase in the density from 60 000 to 80 000 plants ha^{-1} resulted in higher absorption capacity of the growing pods for the uptake of photosynthetic assimilates. This trait was only slightly increased with the increase in density up to 100 000 plants ha^{-1} with no significant difference with that under the density of 80 000 plants ha^{-1}. The effect of weeding frequency was significant on 100-seed weight so that the increase in frequency from two to three improved 100-seed weight. The highest 100-seed weight was obtained under the weeding frequencies of two and three times whereas the lowest one was observed under no-weeding and weeding frequency of one. Despite the increase in 100-seed weight under the weeding frequency of three, its difference with that under the weeding frequency of two was not statistically significant. It seems that since two and three-time weeding was carried out when the conditions was appropriate for the increase in competitiveness of peanut plants on the one hand and the precipitation rate fall gradually after the second and third weeding on the other hand, it is likely that soil moisture content was so changed that the conditions were not appropriate for the germination and establishment of weeds seedlings and their emergence. On the other hand, given the fact that peanut plants had considerably spread transversely during this time, the production of the flowers at this time – during which the competition of the weeds was the lowest – resulted in greater uptake of nutrients and consequently, it positively influenced pods filling. The interaction between plant density and weeding frequency was significant for 100-seed weight, too; i.e., by increasing weeding frequency and plant density, 100-seed weight can be increased owing the uptake and mobilization of more assimilates towards growing seeds. In fact, if the plant density of peanuts can be so increased that the plants have considerable competitiveness after the initiation of the initial and secondary branching of the stalks, then it can be expected to reduce the frequency of weeding in the field. Furthermore, 100-seed weight under the density of 80 000 plants ha^{-1} with weeding frequency of three had no statistical significance with that under the density of 100 000 plants ha^{-1} with weeding frequency of two. Therefore, if plant density is increased only slightly, weeding frequency can be expected to be reduced under field conditions.

References

Anis UR, Well R, Thomas G. 2001. Reproductive allocation on branching of Virginia type peanut cultivars breed for yield in North Carolina. Crop Science **41,** 72-77. http://dx.doi.org/10.2135/cropsci2001.41172x

Bunting AH, Gibbons RW, Wynne JC. 1985. Groundnut (Arachis hypogaea). P. 747–800. In. R.J. Summerfield and E. H. Roberts(ed). Grain legume crops. Collings Technical Books, London.

Chin Choy EW, Stone WC, Matlock JF, Mccauley RS. 1982. Plant population and irrigation effects on Spanish peanut. Peanut Science **2,** 37-76. http://dx.doi.org/10.3146/i0095-3679-9-2-7

Flohr ML, Williams JH, Lens F. 1990. The effect of photoperiod on the reproductive development of a photoperiod sensitive peanut (*Arachis hypogaea*) genotype. NC. Ac 17090. Experimental Agriculture **26 (4),** 397–406. http://dx.doi.org/10.1017/S0014479700001320

Gardner FP, Auma EQ. 1989. Canopy structure, light interception and yield market quality of peanut genotypes as influenced by planting pattern and planting date. Field Crops Research **20(1),** 13–29. http://dx.doi.org/10.1016/0378-4290(89)90020-8

Jaaffar Z, Gardner FP. 1988. Canopy development, yield and market quality in peanut as affected by genotype and planting pattern. Crop Science **28,** 299–305. http://dx.doi.org/10.2135/cropsci1988.0011183X002800020024x

Mixon AS. 1989. Influence of irrigation, row spacing and seeding on yield and market quality of peanut. Applied Agriculture **1(5),** 289–293.

Raghvani BR, Goyal SN, Patel JC. 1984. Crop weeds competition in rainfed groundnut (*Arachis hypogaea* L.). Indian Journal of Weed Science **16(4),** 234–237.

Sultan HB, Hamilton RI, Dwyer LM. 2001. Weed biomass production response to plant spasing and corn (*Zea mays*) hybrids differing in canopy architecture. Weed Technology **15,** 647–653.

Wells R, Anderson WF, Wynne JC. 1991. Peanut yield as a result of fifty years of breeding. Agronomy Journal **83,** 957–961. http://dx.doi.org/10.2134/agronj1991.00021962008300060007x