

EFFECT OF CUTTING NUMBERS AND STUBBLE HEIGHT ON FRESH, DRY FORAGE YIELD , QUALITY AND SEED YIELD OF COWPEA

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ABSTRACT

This experiment was carried out at the Agricultural Experiment and Research Center of Cairo University, Giza, Egypt in 2001 and 2002 seasons. The aim of this investigation was to determine the suitable number of cuttings and stubble height of cowpea to get the highest and best forage and seed yield of cowpea. Four cutting treatments were: one cut at seed harvesting, two cuts, three cuts and four cuts. Three stubble heights were 10, 20 and 30 cm. Taking three cuts significantly surpassed other cutting number treatments in seasonal fresh forage yield in the first season by 34.5, 19.8 and 22.3 % and in the second season by 28.6, 2.4 and 2.4 % for one cut at seed harvesting, two cuts and four cuts, respectively. Leaving 30 cm as a stubble height significantly surpassed other stubble heights in seasonal fresh and dry forage yields of cowpea in the first season. This superiority of seasonal fresh forage yield was 21.5 and 14.4 % in 2001 and the superiority of seasonal dry forage of cowpea was 18.8 and 12.5 % for 10 and 20 cm, in the respective order. Taking three cuts with stubble height at 30 cm significantly gave the highest seasonal fresh and dry yields in the first season. Whereas, in the second season, taking four cuts with the same stubble height (30 cm) significantly recorded the highest seasonal fresh and dry yields. Taking three cuts gave the highest seasonal protein yield in the first season, whereas, in the second season taking four cuts significantly gave the highest seasonal protein yield. Increasing stubble height from 10 to 30 cm increased seasonal protein yield in the first season, but in the second season this increase in seasonal protein yield stopped at 20 cm. The highest pod yield was significantly obtained by taking one cut at seed harvesting in both seasons. Increasing stubble height from 10 to 30 cm gradually increased pod yield with insignificant differences in both seasons. Taking one cut at seed harvesting surpassed the other cutting numbers in seed yield in both seasons. This superiority of seed yield was 64.9, 21.3 and 44.3 % in 2001 and 61.8, 92.7 and 92.3 % in 2002 for two cuts, three cuts and four cuts in the respective order. Increasing stubble height from 10 to 30 cm gradually increased seed yield without significant differences in both seasons.

INTRODUCTION

Cutting date of forage cowpea could be determined by the period between cuttings or the growth stage of the plant. This cutting determination is related to many factors such as site of experiment, variety and the purpose of planting (forage or seeds) etc. In Egypt, the highest total fresh and dry forage yields for some cowpea cultivars were given by taking three cuts at 60, 100 and 140 days from sowing (Mousa and Ghobrial, 1996). In addition, in Egypt, Rafea El-Zanaty (1997) found that the highest fresh yield was obtained by taking three cuts at such dates for cowpea cv. IT83S-872. In India, the maximum cowpea green fodder was obtained by taking cut at 73 days after sowing and this corresponding to pre-flowering stage which recommended for harvesting, whereas, dry yield increased by delaying cut weekly 45 to 94 days after sowing (Chauhan and Tiwana, 1983). In India,

Tsigewoin, *et al.* (2003) found that maximum green and dry fodder yield/cowpea plant was recorded at final harvest (90 days after sowing). In Bangladesh, Rahman, *et al.* (1992) recorded the highest fresh and dry yields of cowpea by taking harvest at 95 days after maturing. In Pakistan, the highest fresh and dry forage yields were obtained by cutting at 105 and 145 days after sowing, respectively, whereas, delaying cut to 165 days, decreased fresh and dry forage yields (Amanullah, *et al.*, 2000). However, In West Lafayette, Indiana, USA, a maximum shoot DW/m² of cowpea was obtained by harvesting at 50 days after planting (Ohler, *et al.*, 1996).

In Egypt, the highest CP yield was recorded by taking three cuts at 60, 100 and 140 days from sowing (Mousa and Ghobrial, 1996). In Ghana, Ahenkora, *et al.* (1998) mentioned that the highest protein yield associated with the dual-purpose cultivars when compared with seed cultivars because the dual-purpose cultivars used extended mean time to maturity by 6 days. In India, crude protein decreased progressively when cowpea was cut weekly 45 to 94 days after sowing (Chauhan and Tiwana, 1983). Also, In India, Nirmal, *et al.* (2001) found that the mean protein percentage of cowpea was 20.3 % when harvested before the flowering stage (25 days after sowing). At 45 days after sowing the mean leaf protein content of 20 genotypes was 18.2 % Then the protein content of cowpea foliage drooped to 10.9 % when cowpea harvested 75 days after sowing (the traditional seed harvest treatment). Also, in Bangladesh, crude protein (CP) content of whole plant of cowpea was 16.2% at 95 days after maturing (Rahman, *et al.*, 1992). Whereas, in West Lafayette, Indiana, USA, average protein content increased from 25 % at 30 days after planting to 45% at 50 days after planting (Ohler, *et al.*, 1996).

In Egypt, Meawed (1997) found that increasing stubble height of fodder cowpeas from 10 to 15 cm almost doubled fresh and dry yields of the second cut. Whereas, the extra longest stubble height (20 cm) caused an additional increase of 37 % in fresh yield and also, dry yield for the same cut. He added that the highest CP content was obtained by stubble height (10 cm) at both cuts. Also he mentioned that cowpea cultivar's Buff gave the highest CP% at both cuts when compared with other cultivars .

Cutting cowpea for seeds also related with many factors such as planting date, cutting date, cultivars, -- etc. In Egypt, El-Zanaty (1997) found that cutting cowpea once gave the highest pod and seed yields. In Ghana, the highest seed yield was obtained by planting cultivar for seed only vs. dual- purpose (Ahenkora, *et al.*, 1998). In India, the highest seed yield was obtained in non- defoliated control treatment. Seed production decreased with delay in harvest and increased in defoliation intensity (Desai, 1980). In India, Srimathi, *et al.*, 1999 harvested cowpea at 10,20,30 and 60 day intervals after 75 days from sowing. They got the highest seed yield (932.2 kg/ha) plants harvested at 20 days followed by 10days interval (915.4 kg/ha). The aim of this investigation was to determine the suitable number of cuttings and stubble height of cowpea to get the highest and best forage and seed yield.

MATERIALS AND METHODS

This experiment was carried out at the Agricultural Experiment and Research Center of Cairo University, Giza, Egypt in 2001 and 2002 seasons. The aim of this investigation was to determine the suitable number of cuttings before seed harvesting and stubble height of cowpea to get the highest and best forage and seed yield. Cowpea seeds (*Vigna unguiculata* (L.) Walp.) were sown on 24th and 20th of June 2001 and 2002 seasons, respectively. Buff cowpea cultivar was sown on 20 cm between hills with 3 seeds in each and 60 cm between ridges. The length of ridge was 4 m. The number of ridges per plot was 4. The plot size was 9.6 m². Berseem and Sugar beet were the previous crops in 2001 and 2002, respectively. A split plot arranged in a Randomized Complete Block design was used in four replications. Cutting treatments occupied the main plots, whereas, stubble heights were arranged in the subplots.

Four cutting treatments were:

- 1- One cut at seed harvesting, i.e. 7 months from sowing.
- 2- Two cuts, after 3 months from sowing and at seed harvesting.
- 3- Three cuts after 3 and 4.5 months from sowing and at seed harvesting.
- 4- Four cuts after 3, 4.5 and 5.5 months from sowing and at seed harvesting.

Three stubble heights were 10, 20 and 30 cm. Amix herbicide (Butralin) at the rate of 2 liter/Fad. was sprayed after planting and before irrigation to control weeds. The cowpea plant was harvested by a hand sickle. Fresh forage yield ton/Fad., dry matter percentage (determined by drying a sample of 200 g from chopped forage in an electric oven at 65° c to constant weight), and dry forage yield ton/Fad. were recorded at each cut. Nitrogen content was determined according to micro-Kjeldahl method (A.O.A.C., 1980). Nitrogen content was multiplied by 6.25 to calculate protein content. Protein yield kg/Fad. was also calculated. The dry pods were collected from each plot and weighed for determination of pods and seed yield for each cut. Data were analyzed by using MSTAT-C computer program 1986-V₄ (Freed, 2005). The mean values for treatments were compared at 0.05 level of significance by using L.S.D. method (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Seasonal Fresh and dry forage yields:

Significant differences were observed between cutting numbers in seasonal fresh and dry forage yields of cowpea in both seasons, except for seasonal dry yield in the first season. Generally, the highest seasonal fresh and dry forage yields were obtained by taking two or three cuts in both seasons (Tables 1 and 2). However, the differences between two, three and four cuts treatments were insignificant for such traits in both seasons. Taking three cuts significantly surpassed other cutting number treatments in seasonal fresh forage yield in the first season by 34.5, 19.8 and 22.3 % and in the second season by 28.6, 2.4 and 2.4 % for one cut at seed harvesting, two cuts and four cuts, respectively (Tables 1 and 2). Similar results were found in Egypt by Mousa and Ghobrial, (1996) and Rafea El-Zanaty (1997).

Cutting once at seed harvesting significantly gave the lowest fresh and dry yields in both seasons . These findings may be logic since sequential cuttings to some extent limit may encourage buds to produce more branches resulted in more vegetative growth .

Table (1): Effect of cutting numbers and stubble height of cowpea on seasonal fresh, dry forage yields (ton/Fad.) and protein yield (kg/Fad.) in 2001 season*

Cutting numbers	Stubble height (cm)			Mean
	10	20	30	
Seasonal fresh forage yield				
One cut	14.4	12.3	11.9	12.9 B
Two cuts	16.3	15.3	15.7	15.8 AB
Three cuts	14.5	18.4	26.1	19.7 A
Four cuts	11.5	16.0	18.5	15.3 AB
Mean	14.2 b	15.5 b	18.1a	15.9
Seasonal dry forage yield				
One cut	4.4	3.8	3.6	3.9 A
Two cuts	3.5	3.9	4.5	4.0 A
Three cuts	4.1	4.9	6.8	5.3 A
Four cuts	3.4	4.3	4.3	4.0 A
Mean	3.9 b	4.2 b	4.8 a	4.3
Seasonal protein yield				
One cut	487.8	458.4	405.2	450.5 A
Two cuts	368.1	451.9	526.0	448.7 A
Three cuts	419.0	571.1	836.6	608.9A
Four cuts	344.3	503.3	529.0	458.9 A
Mean	404.8 c	496.2 b	574.2a	491.7

Fresh Dry Protein
LSD_{0.05} (C x S) 3.7 1.1 116.8

*In this table and following ones, means followed by the same letter(s) are not significantly differed.

Table (2): Effect of cutting numbers and stubble height of cowpea on seasonal fresh, dry forage yields (ton/Fad.) and protein yield (kg/Fad.) in 2002 season

Cutting numbers	Stubble height (cm)			Mean
	10	20	30	
Seasonal fresh forage yield				
One cut	16.6	15.6	12.9	15.0 B
Two cuts	20.4	20.0	21.0	20.5 A
Three cuts	21.6	21.7	19.6	21.0 A
Four cuts	17.4	20.5	23.6	20.5 A
Mean	19.0 a	19.5 a	19.3a	19.3
Seasonal dry forage yield				
One cut	3.0	2.5	2.3	2.6 B
Two cuts	3.0	3.0	3.4	3.1 A
Three cuts	3.4	3.3	3.0	3.2 A
Four cuts	2.7	3.4	3.7	3.3 A
Mean	3.0 a	3.1 a	3.1 a	3.1
Seasonal protein yield				
One cut	335.6	308.2	253.0	298.9 B
Two cuts	331.6	361.5	402.9	365.3 A
Three cuts	385.2	396.4	349.7	377.1 A
Four cuts	302.1	396.2	434.3	377.5 A
Mean	338.6 b	365.6 a	360.0 a	354.7

Fresh Dry Protein
LSD_{0.05} (C x S) 5.4 0.8 51.1

Leaving 30 cm as a stubble height gave the highest seasonal fresh and dry forage yields in both seasons. These findings were in harmony with those obtained by Meawed (1997) who mentioned that increasing stubble height from 10 to 15 cm doubled fresh and dry yields at the second cut in both seasons. Leaving 30 cm as stubble height was surpassed other stubble heights in seasonal fresh and dry forage yields in the first season. This superiority of 30 cm over 10 and 20 cm in seasonal fresh forage yield was 21.5 and 14.4 % and in seasonal dry forage yield was 18.8 and 12.5 % in 2001, respectively. However, no significant differences were observed between stubble heights in seasonal fresh and dry forage yields in the second season. Leaving 30 cm stubble height may contain more buds than others (10 and 20 cm) which led to more branches to be initiated with more leaves resulted in the wideness of the canopy surface and more efficient utilization of the exposure light. Increasing stubble height from 10 to 30 cm increased seasonal fresh and dry yields gradually in the first season, whereas, in the second season, this increase in seasonal fresh and dry yields stopped at 20 cm stubble height.

Taking three cuts with leaving stubble height at 30 cm significantly gave the highest seasonal fresh and dry yields in the first season. Whereas, in the second season, taking four cuts with the same stubble height (30 cm) significantly gave the highest seasonal fresh and dry forage yields (Tables 1 and 2). Therefore, more cuts resulted in more fresh and dry yields of cowpeas. In addition, cuttings at a stubble height of 20 or 30 cm may be recommended to produce forage yields.

Protein Yield:

Same trend that shown in fresh and dry yields was also came up again in protein yield. Taking three cuts gave the highest seasonal protein yield in the first season. Similar results were found by Mousa and Ghobrial, (1996). In the second season, taking four cuts gave the highest seasonal protein yield. Cutting once at seed harvesting gave the lowest seasonal protein yield in both seasons (Tables 1 & 2). The similar trend was shown for stubble height treatments in seasonal fresh and dry yields was appeared again. Increasing stubble height from 10 to 30 cm increased seasonal protein yield gradually in the first season. In the second season, this increase in protein yield stopped at 20 cm and then decreased with increasing stubble height from 20 to 30 cm. The highest seasonal protein yield was recorded with taking three cuts with 30 cm stubble height in the first season. In the second season taking four cuts with such stubble height gave the highest seasonal protein yield (Tables 1 and 2). It well known that protein percentage decreases with plant age advance. This may be shown in the results of this study since sequential cuttings to an extend limit may encourage buds to produce more branches resulted in more vegetative growth with many leaves that contain more protein percent than stems on one hand. On the other hand many leaves were fallen with delaying cut to seed harvesting. In India, Nirmal, et al. (2001) found that the mean protein percentage of cowpea was 20.3 % when harvested 25 days after sowing. At 45 days after sowing the mean leaf protein content was 18.2 % then dropped to 10.9 % when cowpea harvested 75 days after sowing (the traditional seed harvest treatment).

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Pod Yield:

The highest pod yield was significantly obtained in non-defoliated control treatment (one cut at seed harvesting) in both seasons. Pod production decreased with taking more cuts before seed harvesting. This may be due to the encouragement of cutting to vegetative growth stage rather than reproductive stage and also to the exhaustion of reserved carbohydrates in producing new branches. Non-defoliated control treatment significantly surpassed the other treatments in pod yield in both seasons. This superiority of pod yield was 70.4, 33.3 and 52.5 % in 2001 season and 61.7, 92.2 and 91.8 % in 2002 season for two, three and four cuts in the respective order.

Increasing stubble height from 10 to 30 cm gradually increased pod yield with insignificant differences between them in both seasons.

Cutting once at seed harvesting with leaving 10 and 30cm as a stubble height significantly gave the highest pod yield in the first and the second seasons, respectively. However, no significant differences were observed between stubble heights with cut once at seed harvesting in both seasons (Tables 3 and 4).

Table (3): Effect of cutting numbers and stubble height of cowpea on pod and seed yields (kg/Fad.) in 2001 season

Cutting numbers	Stubble height (cm)			Mean
	10	20	30	
Pod yield				
One cut	313.0	259.0	312.0	294.7 A
Two cuts	59.0	113.7	88.7	87.1 B
Three cuts	170.7	186.4	232.7	196.6 AB
Four cuts	137.7	142.6	139.4	139.9 AB
Mean	170.1 a	175.4 a	193.2 a	179.6
Seed yield				
One cut	142.6	126.6	124.4	131.2 A
Two cuts	30.5	57.4	50.2	46.0 A
Three cuts	89.8	96.4	123.3	103.2 A
Four cuts	70.1	64.2	85.0	73.1 A
Mean	83.3 a	86.2 a	95.7 a	88.4

LSD_{0.05} (C x S) Pod yield 111.8 seed yield 54.5

Table (4): Effect of cutting numbers and stubble height of cowpea on pod and seed yields (kg/Fad.) in 2002 season

Cutting numbers	Stubble height (cm)			Mean
	10	20	30	
Pod yield				
One cut	1077.4	1126.1	1169.9	1124.5 A
Two cuts	428.4	414.2	448.5	430.4 B
Three cuts	71.0	98.0	95.4	88.1 C
Four cuts	76.3	113.8	87.5	92.5 C
Mean	413.3 a	438.0 a	450.3 a	433.9
Seed yield				
One cut	569.3	577.5	656.1	601.0 A
Two cuts	230.7	221.7	236.3	229.6 B
Three cuts	34.7	50.3	46.1	43.7 C
Four cuts	40.5	59.0	39.7	46.4 C
Mean	218.8 a	227.1 a	244.6 a	230.2

LSD_{0.05} (C x S) Pod yield 270.9 Seed yield 132.1

Seed Yield:

The highest seed yield was significantly recorded in non-defoliated control treatment (one cut at seed harvesting) in both seasons, except in the first season no significant differences were observed between cutting numbers in seed yield. Seed production decreased with taking more cuts before seed harvesting. This may be due to the encouragement of cutting to vegetative stage rather than reproductive stage and also to the exhaustion of reserved carbohydrates that produce new branches. Taking one cut at seed harvesting significantly surpassed other treatments in seed yield in both seasons. This superiority of seed yield was 64.9, 21.3 and 44.3 % in 2001 and 61.8, 92.7 and 92.3 % in 2002 for two, three and four cuts treatments in the respective order. Increasing stubble height from 10 to 30 cm gradually increased seed yield with insignificant differences in both seasons. Taking one cut at seed harvesting with 10 and 30 cm significantly gave the highest seed yield in the first and second seasons, respectively. However, no significant differences were observed between stubble heights with taking one cut at seed harvesting in both seasons (Tables 3 and 4). These results are agree with those obtained by Rafea El-Zanaty (1997) In Egypt, she found that cutting cowpea once gave the highest pod and seed yields. Also, In India, the highest seed yield was obtained in non-defoliated control treatment (Desai, 1980).

It is noteworthy that pod and seed yields were lower in the first season than that in the second season. This may be due to the damage caused by some seed borne insects.

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تأثير عدد مرات الحش وارتفاع الكرسى على حاصل العلف الأخضر والجاف والجودة وغلة البذور في لوبيا العلف

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أقيمت تجربتان حقليةتان بمركز البحوث والتجارب الزراعية بجامعة القاهرة فى عام ٢٠٠١، ٢٠٠٢ كان الهدف من البحث دراسة تأثير عدد مرات القطع المناسبة وارتفاع الكرسى للوبيا العلف للحصول على أعلى حاصل من العلف الأخضر والجاف ذو جودة عالية وأعلى غلة من البذور. ولذلك استخدمت أربع معاملات للقطع وهى القطع مرة واحدة عند حصاد البذور، والقطع مرتين الأولى بعد ثلاثة شهور من الزراعة والثانية عند حصاد البذور، والقطع ثلاث مرات الأولى بعد ثلاثة شهور من الزراعة والثانية بعد شهر ونصف من الأولى والثالثة عند حصاد البذور، والقطع أربع مرات الأولى بعد ثلاثة شهور من الزراعة والثانية بعد شهر ونصف من الأولى والثالثة بعد شهر من الثانية والرابعة عند حصاد البذور. واستخدم ثلاث معاملات لارتفاع الكرسى هى ١٠ و ٢٠ و ٣٠ سم. ومن النتائج وضح تفوق معاملة القطع ثلاث مرات على باقى معاملات القطع فى حاصل العلف الأخضر الكلى بنسبة ٣٤.٥، ١٩.٨، ٢٢.٣% فى الموسم الأول و بنسبة ٢٨.٦ و ٢.٤ و ٢.٤% فى الموسم الثانى. عند مقارنتها بمعاملة القطع مرة واحدة ومرتين وأربع مرات على التوالي. وتفوق القطع على ارتفاع ٣٠ سم معنوياً على باقى معاملات ارتفاع الكرسى فى حاصل العلف الأخضر والجاف الكلى بنسبة ١٤.٤ و ٢٦.٥% و بنسبة ١٨.٨ و ١٢.٥% على معاملة ١٠ و ٢٠ سم على التوالي فى الموسم الأول. أعطى القطع ثلاث مرات وأربع مرات مع ترك ٣٠ سم أعلى حاصل علف أخضر وجاف كلى فى الموسم الأول والثانى على التوالي. وأعطت معاملة القطع ثلاث مرات وأربع مرات أعلى حاصل بروتين كلى فى الموسم الأول والثانى على التوالي. أدت زيادة ارتفاع الكرسى من ١٠ إلى ٣٠ سم إلى زيادة حاصل البروتين الكلى فى الموسم الأول بينما فى الموسم الثانى توقفت الزيادة عند ٢٠ سم. وحصل على أعلى حاصل للقرون والبذور عند القطع مرة واحدة عند الحصاد فى الموسمين. وزيادة ارتفاع الكرسى من ١٠ إلى ٣٠ سم زود حاصل القرون والبذور زيادة تدريجية ولكنها غير معنوية فى الموسمين. تفوقت معاملة القطع مرة واحدة عند الحصاد فى حاصل البذور بنسبة ١٤.٩ و ٢١.٣ و ٤٤.٣% فى الموسم الأول بينما كانت فى الموسم الثانى ١١.٨ و ٩٢.٧ و ٩٢.٣% على معاملة القطع مرتين وثلاث وأربع مرات على التوالي. توصى هذه الدراسة بالحش ثلاث مرات على ارتفاع ٢٠ أو ٣٠ سم للكرسى للحصول على أعلى حاصل من العلف الأخضر والجاف للوبيا العلف. والحش مرة واحدة وقت الحصاد للحصول على أعلى غلة من البذور.