Assiut J. Agric. Sci., 52 (5) 2021 (25-44) *ISSN: 1110-0486*
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Impact of Cutting System and Different Application of Potassium Fertilizer on Seed Production and its Quality of Forage Cowpea

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Accepted for publication on: 31/12/2021

Abstract:

Two field experiments were carried out during two successive summer seasons of 2018 and 2019 at Kafr Al-hamam Agricultural Research Station Sharkia government, Agric. Research Center (ARC). The aim of this work, to study the effect of three cutting system *i.e.* (without cut, after one cut and two cuts) and six potassium fertilizer application (control, 100% K as soil, 50% K as soil + K as foliar spray at flowering stage, 50% K as soil + K as foliar spray at flowering and pods filling stages, 25% K as soil + K as foliar spray at flowering stage and 25% K as soil + K as foliar spray at flowering and pods filling stages) on seed production and seed quality parameters of cowpea crop. The most important results are summarized as follows:

Seed production without cut of plants or after once cut generally, increased plant height, number of seed plant^{-1}, number of pods plant^{-1}, pod length, weight of pods plant^{-1}, 100 weight seed, harvest index and seed yield. The increases of seed yield after the first cut and the second cut compared by without cutting system reached 54.56 and 44.08 %, respectively. Also, germination%, seedling vigor index 1 and 2, shoot and radical lengths as well as fresh and dry weight of seedling were decreased of seed obtained after twice cut of cowpea on basis combined data.

In general, K fertilizer significantly affected the seed yield attributes except plant height. Potassium fertilizer application of 50% potassium as soil + potassium as foliar spray at flowering and pods filling stages increased seed yield fad.$^{-1}$ with 55.84% over control. On the other side, using of the same application of Potassium fertilizer was effective in producing higher seed viability and vigor over control in combined data.

The two cutting systems which were left plants without cut then taken seeds or taken seeds after once cut fertilized by 50% potassium as soil + potassium as foliar spray at flowering and pods filling stages produced the highest seed yield fad.$^{-1}$ (649.01 and 617.47 kg), respectively. Also, most quality parameters were increased and improved under this treatment compared with other treatments.

According to results of present study, it also recorded the highest net return per one invested L.E. (2.29L.E.). It can be included that farmers can obtain the same cowpea yield if they once were cutting system with applying Potassium fertilizer of 50% potassium as soil + potassium as foliar spray at flowering and pods filling stages. In this way, it is possible to take a cut as green fodder that contributes to filling the feed gap during the summer months on the other hand, reduce the expensive potassium fertilizers were added on as ground and replace them with foliar spray fertilizers help to reduce environment pollution, as well as the basic goals of produced a better seeds quantity and quality with the lowest cost in terms of yield.

To achieve highest seed yield with concerning quality of cowpea, its recommended to obtain seeds after once cut with treatment of 50% potassium as soil application + 50% potassium as foliar application at flowering and pods filling stages respectively

Keyword: *Cowpea, cutting system, potassium fertilizer, seed yield and seed quality.*

Introduction

Cowpea [*Vigna unguiculata* (L). Walp] is one of the most important legume forage crops, it is drought/shade tolerant, quick growing, high yielding, with substantially rich biomass production, grows well with associated crops. For fodder production, it is mainly grown as mixed/ intercrop with cereals. Nevertheless, in forage legumes, quality seed production and availability are lacking (Taipodia and Nabam 2013). However, the non-availability of good quality cowpea seed is a serious problem in developing countries throughout the world leading to little availability of good quality fodder to animals which is one of the major reasons for low milk and meat productivity in Egypt. The scarcity of good quality green legume fodder is more serious during the summer months when farm animals require the most for their growth and development compared with during the winter season. Although good agronomic practices like optimum time of harvest, fertilization, have significant positive influence on seed yield, however, environmental conditions like temperature, soil moisture and relative humidity during the reproductive phase play an important role for seed formation and development in seed yield of cowpea (Kumar and Sarlach, 2015 and Sarma *et al*., 2014).

Cutting system of cowpea for seed produced related with many factors such as planting date, number of cutting, cultivars… etc, in Egypt, El-Zanaty (1997) showed that cutting cowpea once gave the highest pod and seed yields. In India, the highest seed yield was obtained in non-defoliated control treatment (Ahenkora *et al*. 1998). In Egypt, El- Zanaty (2006) indicated that taking one cut and left plant to seed harvesting surpassed the other cutting numbers in seed yield in both seasons. Cutting systems are one of the most important determinants of seed production through their effect on the length of period and the environmental conditions influence on the development and quality of seed (Chemutai *et al*. 2018).

Potassium is one of the principal plant nutrients underpinning crop yield production and quality determination. While involved in many physiological processes, potassium's impact on water relations, photosynthesis, assimilate transport and enzyme activation can have direct consequences on crop productivity. Studies aimed toward increasing crop productivity and improved quality direct either increased potassium supply or more efficiency use of potassium (Pradeepa and Ganajaximath (2017).

Muoneke *et al*. (2015) showed that the growth and yield of vegetable cowpea responded better to K application over check. Increase in K application progressively increased the leaf area index, plant length as well as fresh yield of the crop. It was recommended that farmers should apply 45 kg/ha K_2O to ensure better yield and yield attributes of fodder cowpea. The seed yield and their quality of cowpea was significantly influenced by mode of fertilizer application (Cuellar *et al*. 2010, and Yadav *et al*. 2002). Therefore, foliar application is a very good implement for enriching plants, where can uptake nutrients through their leaves considerably faster than roots and these cause less environmental pollution (Tahir *et al*. 2014). Mohamed *et al*. (2010) found that in the study on quality parameters of seeds. Foliar application of (K) as a fertilizer application is considered active way and lead to increases the absorption of potassium and other nutrients and ultimately increases the seed yield and the most its components. Panda *et al*. (2018) and Abid *et al*. (2016) stated that increasing in seed yield with foliar application of k was due to increase pod length, pods plant^{-1}, seeds pod^{-1}, seed yield plant^{-1} and 100-seed weight. El Karamany *et al*. (2019) reported that, with the passage of time, climate change is likely to accentuate the frequency and intensity of heat stress and drought which definitely will affect the seed yield and quality of crops particularly in tropical and subtropical areas of the world. We therefore hypothesized that under such conditions, foliar sprays of k will be equally effective, easy and economical approach for increasing the seed yield and its quality parameters of mungbean plants.

Still know a little about how seeds are produced and knowing the impact of most important environmental and agricultural factors on Physiological processes that determine seed quality produced. the present research was intended with the following objectives:

- To determine the appropriate cutting system and optimum potassium fertilizer application for higher seed production of fodder cowpea.
- Studying seed quality is important to many growers, dealers, and users seed, demand for seed quality information Increased. Therefore, the aim of this study was to determine the most suitable cutting system with the best application of potassium fertilization to obtain high quality seeds.
- Economic evaluation of cowpea under the different cutting systems and potassium fertilizer applications for knowing the optimal system of cutting and potassium used to reach the highest economic yield of green and seeds yields with high quality seeds by lowest costs with highest return.

Materials and Methods

Site Description

A field experiment was conducted for two successive summer seasons of 2018 and 2019 at Kafr Al-Hamam Research Station (ARC), Sharkia governorate, Egypt, to study the effect of cutting number, K fertilizer and their combinations on seed yield and quality of forage cowpea (*Vigna unguiculata* L.) local cultivar cv. Baladi was used. The soil texture of the experimental site was clayey as shown in Table 1, according to the analytical methods described by Black *et al.* (1982). The Meteorological data for East of Delta region in 2018 and 2019 summer seasons are shown in Table 2.

Table 1. Mechanical and chemical analyses of the experimental soil sites during the two summer successive seasons of 2018 and 2019

Soil characteristics	season 2018	Season 2019
Mechanical analysis		
Find sand %	18.55	14.83
Silt %	26.80	28.95
Clay %	54.65	56.22
Texture	Clay	Clay
Chemical analysis		
PH	7.55	7.85
EC dS m^{-1}	2	2.3
Organic matter %	1.42	1.20
Available macro nutrients (ppm)		
N	25.40	22.06
P	18.00	16,4
K	280.44	268.15

Table 2. Monthly average maximum temperature (Max.), minimum temperature (Min.), relative humidity (RH) and precipitation (P) in 2018 and 2019 growing seasons of cowpea at the experimental site

Month	Temperature (°C)			RH (%)	P(mm)
	Max.	Min.	Average		
2018 season					
May	36	18	27	36	0.002
June	38	22	30	43	0.0
July	39	23	31	42	0.0
August	39	23	31	43	0.0
September	36	21	29	51	0.0
October	36	20	28	52	0.0
2019 season					
May	32	16	24	53	0.004
June	36	19	28	42	0.001
July	39	22	31	43	0.0
August	39	23	31	45	0.0
September	38	23	31	51	0.0
October	36	22	29	52	0.0

Weather data during the growing seasons were obtained from Agriculture Research Meteorological Station near the experimental site

Experimental design

The experimental layout was arranged in a randomized complete block design with three replicates. The three cuttings and the K fertilizer applications were main factors.

Cutting systems

Seed yield: were obtained in first treatment, without cut until seeds harvesting (C1), the second treatment.

: Were obtained after one cut and left the plants until seeds harvesting (C2), and the third treatment.

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:Were obtained after second cut and left the plants until seeds harvesting (C3).

Potassium fertilizer applications

1- Control (no fertilizer) (K1).
2- 100% K as soil application (48 kg Kfad^{-1}.) (K2).
3- 50% K as soil application (24 kg Kfad^{-1}.) + K as foliar spray application at flowering stage (K3).
4- 50% K as soil application (24 kg Kfad^{-1}.) + K as foliar spray application at flowering and pod filling stages (K4).
5- 25 % K as soil application (12 kg Kfad^{-1}.) + K as foliar spray application at flowering stage (K5).
6- 25 % K as soil application (12 kg K fad^{-1}.) + K as foliar spray application at flowering and pod filling stages (K6).

Management and sampling

The preceding crop for both seasons was wheat (*Triticum aestivum* L.). Sowing dates were on 13th and 16th May in the two successive seasons of 2018 and 2019, respectively. The plot area was 10.5 m^2 (3.5 x 3 m) *i. e.* 5 ridges each of 0.7 m width and 3 m long. Seeds were drilled in hills, 20 cm apart with 10 kg fad^{-1} seeding rate. Fertilized N treatments received 15 Kg N fed^{-1} in the form of ammonium nitrate (33.5% N) in two doses after seed germination and before irrigation as an encouraging dose for growth. Each of calcium superphosphate (15.5% P_2O_5) at the rate of 150 kg fad^{-1} and potassium sulphate (48% K_2O) at the rates of 48, 24 and 12 kg fad^{-1} were applied before sowing as soil addition. While potassium foliar spray Potassium P (32% K_2O and 5% P_2O_2) was used at a rate of 1L / 300L water fad^{-1} was applied once during the flowering stage and the second spray during the pod filling stage. The plots were weeded twice where the first weeding was done two weeks after emergence and the second weeding was done just before flowering. The first cut was taken after 60 days from sowing and the next cut was done after 35 days from the first cut in both seasons then the cowpea crop was left for flowering and seed production. The plants were harvested at the seed maturity stage for each treatment. All other cultural practices were conducted as recommended for cowpea crop under the same conditions. Harvest was done on October 22 and 29 for the two successive seasons of the season 2018 and 2019, respectively.

Data recorded at harvest

Fresh forage yield (ton fad.$^{-1}$): Forage yield was recorded for the first and the second cut according to the cutting system treatments. At time of cutting an area of 10.5 m^2, was cut where weighed and forage yield was calculated. Data for fresh forage yield as (ton fad^{-1}) (fad= faddan = 4200 m^2).

Seed yield and its attributes: At pod maturity, ten plants were randomly taken from each plot and tagged for plant height (cm), number of pods plant^{-1}, number of seeds pod^{-1}, pod length (cm), 100-seed weight (g), and harvest index as well as seed yield (kg fad^{-1}) were all measured.

Laboratory experiment:

At the Laboratory of seed technology Res. Depart., Field Crops Res. Inst., ARC, Giza. Two experiments were conducted for two successive seasons, after harvest and seed processing of both, field experiments during 2018 and 2019 season to investigate the effect of cutting system and potassium fertilizer applications on viability and vigor seeds which collected from the above-mentioned field experiments.

Data recorded

Germination test: seeds were incubated in moist filter paper at 25°C for 8 days. The result of germination test is calculated as the average of the 100 seed replicates Normal seedlings were counted according to international rules of I.S.T.A. (1996) and expressed as germination percentage at the final count, then ten seedlings were randomly selected and measured shoot and radical lengths (cm) as well as seedling fresh and dry weight (g) according to Krishnasamy and Seshu (1990). Germination percentage: n / N X 100. Where, n is the number of germinated seeds, N is the number of total seeds planted. Fresh and dry weight of seedling (g) the seedlings were put into paper packet separately and placed into the preheated oven dry weight was taken after 3 days at 70 °C. Seedling vigor index: was determined according to the formula given by Reddy and Khan (2001).

Seedling vigor index (1) = Germination percentage X Seedling length

Seedling vigor index (2) = Germination percentage X Seedling dry weight

Economic evaluation

The economic evaluation included the following three criteria: average input variables, total production costs of forage and seed yields for cowpea used in the study, the cutting systems and different K fertilizer applications as well as other agricultural practices applied during the growth stages.

The total revenue of the farm from forage crops grown cowpea for the different cutting systems used. Net farm return forage crops production as affected by applied applications. It's calculated as the difference between the forage and seed yields values and the total costs according to the actual prices (Note that the price per ton of green forage was 400 L.E. $fad.^{-1}$). All fertilizers and seed prices and the costs of all farm operations are based on the official and the actual market prices determined by Egypt Ministry of Agriculture (Economic Reports, 2020). Total costs included values of production tools and requirements such as seeds, fertilizers, irrigation, man, power, machinery and other general or different costs as well as land rent average.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) according to procedures outlined by Snedecor and Cochran (1989) using MSTAT-C computer software package (1986) and the means were separated using Least Significant Difference (LSD) at $P<0.05$. Data of the fresh forage yield analysis was done for the two cutting treatments once and twice and the potassium fertilization treatments as a soil addition only. The combined analysis of variance across the two seasons for all studied traits were subjected to a regular statistical analysis of variance according to Gomez and Gomez (1984) using the same computer software package (MSTAT-C).

Results and Discussion

Fresh forage yield

1- Effect of cutting system

Data related to fresh forage yield (ton fad.$^{-1}$) as influenced by cutting system and K fertilizer applications during two growing seasons and their combined are presented in Table 3. The statistical analysis for fresh forage yield showed asignificant difference between the two cutting systems in both season and combined analysis. It is apparent from the data of the combined analysis that, taking two cuts significantly surpassed compared with taking once cut in the season. The values of forage yield after once cut (60 days) and the twice cutting (60 and 35days) were estimated at 10.88 and 14.33 tons fad^{-1}., respectively in combined data. Whereas the increase in forage yield due to twice cutting reached 31.7% over once cutting. Similar results were found in Egypt by Rafea El-Zanaty (1997) she found that cutting once at seed harvesting significantly gave the lowest fresh yield in both seasons.

2- Effect of Potassium fertilizer applications

Regarding the effect of potassium fertilizer applications on forage yield, the results in Table 3, the data of combined analysis showed significant effect in forage yield among K fertilizer applications. forage yield positively responded to application K fertilizer up to the lowest rate 25% K as compared to the control**.** The possible reason for these improvement in forage yield, Potassium leading to increasing growth during the productive phase for cowpea crop, even if the potassium content in the soil was sufficient to maintain good vegetative growth. However, Chemutai *at al.* (2018) found that Potassium is an essential nutrient for legumes, it is an activator for many enzymes, especially those involved in protein synthesis. Potassium also has an important role in maintaining water balance in the plant. In legumes, potassium is necessary for the proper development and functioning of root nodules. Rhizobia bacteria in the nodules fix atmospheric nitrogen and make it available to the legume plant. If nitrogen fixation is affected by potassium deficiency, the legume will suffer a nitrogen shortage and reduced yield. Moreover, any increasing the percentage of K from 25 to 100% K did not effect on productivity of forage yield on basis of combined data. The reason is that the ground stock of potassium may be sufficient to supply plants with the necessary requirements during the vegetative growth stage also, indicates that an increase in potassium levels is not followed by a corresponding increase in forage yield. The results are in close agreement with those of Fixen and Reetz (2006).

3- Effect of cutting system and K fertilizer interaction on forage yield

The interaction effect between cutting system and K fertilizer applications on forage yield was insignificant.

Table 3. Fresh forage yield (ton fad^{-1}) of cowpea as influenced by K fertilizer application in two seasons and their combined

Main effects and interactions		Fresh forage yield (ton fad.$^{-1}$)		
		1st season	2nd season	Com.
Cutting system (C)				
After once cut (C1)		10.10	11.67	10.88
After twice cut (C2)		14.54	14.12	14.33
LSD 0.05		1.41	1.19	2.46
Potassium fertilizer application (K)				
Control (K1)		10.33	11.40	10.86
100% K (K2)		13.09	13.48	13.28
50% K (K3)		13.02	13.41	13.21
25% K (K4)		12.85	13.29	13.06
LSD 0.05		0.56	0.72	0.24
Interaction (CXK)				
C1	**K1**	8.00	10.33	9.16
C1	**K2**	10.83	12.22	11.52
C1	**K3**	10.83	12.16	11.49
C1	**K4**	10.76	11.97	11.36
C2	**K1**	12.66	12.47	12.56
C2	**K2**	15.35	14.75	15.05
C2	**K3**	15.22	14.66	14.94
C2	**K4**	14.94	14.61	14.77
LSD 0.05		NS	NS	NS

Seed yield and its component

1- Effect of cutting system on seed yield and its attributes

Data of the combined analysis presented in Tables 4 and 5 showed the seed yield and its main components such as plant height, number of pods plant^{-1}, number of seeds pod^{-1}, pod length, pods weight plant^{-1} and 100-seed weight, harvest index and seed yield were significantly affected by cutting system, it is clear from the data that left the plants for seed production without cutting or taken the seed after the first cut gave a significant increase in seed yield and most of the other characters compared by after twice cut. Whereas, the increases were between without cutting or once cut and twice cutting systems reached 34.95 and 22.10% in plant height, 8.91 and 21.81% in number of pods plant^{-1}, 10.03 and 36.31 % in 4number of seeds pod^{-1}, 11.10 and 40.89% in pod length, 5.60 and 48.68% in pods weight plant^{-1}, 4.29 and 68.10% in 100-seed weight as well as 54.56 and 44.08% in seed yield, respectively in combined data. However, it is noticeable that the differences between the first and the second systems are less and its most insignificant than the differences between the first and the third systems of the seed yield and main seed components. On the other side, the first system was expected to thesuperiority of seed yield for the largest the number of pods plant^{-1} and number of seeds plant^{-1} are important and effective parts in determining the yield during favorable weather with the presence of active pollinating insects, but the longer the pods stay on the mother plants, especially those that are produced early with high relative humidity among the canopy, which greatly increases the chance of exposure and attack and infestation with pests. It is considered that insect pests are the main biological constraint of cowpea and each stage of cowpea. Hence, the first system of cutting systems was more susceptible to various pests. These results are in harmony with those reported by (Delouche 1980). While, in the second system, cowpea plants may be able to produce flowers and pods out of synchrony with the life cycle of most pods insects, and thus escape attack and injury by pests. This may explain the absence of significant differences in the first and second cutting systems. These findings are in line with the reports of (Rahman *et al.* 2013) and (Dube and Fanadzo 2013). Also, (Li *et al*. 2005) conducted that the indeterminate cultivars tend to increase biomass partitioning to leaves through delayed reproductive development, which allows separated plants to produce more new leaves. On the contrary, twice cut decreased the rate of pod filling and shortened effective duration of pod filling compared with cutting systems. Reduction in the source of assimilates at twice cut caused lower seed yield at harvest is very evident. These results are in accordance with the findings of several other workers Ahenkora *et al.* (1998) and El- Zanaty (2006) indicated that taking one cut at seed harvesting surpassed the other cutting numbers in seed yield in both seasons.

2- Effect of Potassium fertilizer applications on seed yield and its attributes

Tables 4 and 5 revealed that adding K fertilizer resulted in significant increments respecting all characters under study compared with control except plant height did not show significant response to adding K fertilizer. The highest values of seed yield and the studied seed traits were recorded with K4 treatment (50% K as soil application + one foliar spray at flowering and one foliar spray at pod filling) directly followed byK6 treatment (25% K as soil application + one foliar spray at flowering and one foliar spray at pod filling). Application of (50% K as soil application + one foliar spray at flowering and one foliar spray at pod filling) significantly increased the No. of pods plant^{-1} (14.98), No. of seed plant^{-1} (14.88), pod length(14.09cm), weight of pods plant^{-1} (28.18), 100 weight seed (14.15g) and seed yield (554.46k g fad.$^{-1}$) compared to control. An increase in number of pods plant^{-1} played a major role in increasing the total seed yield and this improvement was mainly due to the increased nutrient supply and reduced nutrient losses. Soil addition of potassium fertilization with addition of foliar potassium fertilization during two critical stages perhaps helped in quick absorption of nitrogen and phosphorous, at the time of reproductive stage where the nutrient demand is at the peak due to indeterminate growth habit of the crop. Hence higher seed it reduced the flower drop and ultimately enhanced the pod setting and resulted in yield. The results are corroborating with the findings of Pradeepa and Ganajaximath (2017) and Shashikumar *et al.* (2013) in cowpea who revealed that foliar spray of at branching and flowering stages recorded significantly higher growth and yield parameters and yield over other treatments.

3- Effect of cutting system and K fertilizer interaction on seed yield its attributes (C)

Potassium fertilizer application (K)

The interaction between cutting system and K fertilizer application, the present data in Tables 4 and 5 revealed that, cutting system x Potassium fertilizer application affected significantly the seed yield and its component in combined data except for plant height. Likewise, first cutting system and fertilized by (50% K as soil application + foliar spray at flowering and pod filling stages) or fertilized by (25% K as soil application + foliar spray at flowering and pod filling stages) recorded in the highest values for No. of pods plant^{-1} (16.96 and 16.83), No. of seed plant^{-1} (17.49 and 17.16), pod length (17.20 and 16.54cm) as well as seed yield (649.01 and 617.47 kg fad.$^{-1}$), respectively. The increase is attributed to many factors that have been proven to affect seed productivity, such as the length of period and environmental conditions for that period during the reproduction phase, which are determined through the cutting systems used under this study, as well as the addition of potassium fertilizer, especially foliar applications with a rapid response and least possible loss during the critical stages of seed development. These findings are in conformity with Sumalatha and Uppar 2018, they reported that on soybean, the optimum climate and sufficient time for growth and pod filling and using foliar spray soluble fertilizers containing major nutrients at critical growth stages might have resulted in quick and spot availability of optimum quantity of nutrients in required form. This resulted in better absorption of nutrients by leaves which might have helped in the production of a greater number of flowers and pods per plant, better seed setting, more number of developed seeds ultimately higher seed weight. So significantly highest seed yield.

Laboratory experiment

Quality seed production in cowpea and seed availability is a felt need among the farmers. The laboratory experiments were conducted on the seeds harvested from the above-mentioned field experiments of cutting system and K fertilizer on cowpea (cultivar Baladi). One of the objectives of this study produce high quality cowpea seeds by determining which system is optimal for cutting with best applying of k fertilizer applications of cowpea in Egypt.

Effect of cutting system

Results in Tables 6 and 7 showed that germination % and seedling traits were significantly affected to different extents by cutting system and K application. The highest values of germination %, seedling vigor index (1) and (2), shoot and radical lengths as well as fresh and dry weight seedlings were obtained from left plants without cutting and also, from seeds product after once cut of germination % (93.21 and 92.58 %), seedling vigor index 1 (2263.43 and 2112.93), seedling vigor index 2 (7.50 and 6.09), shoot length (18.99 and 17.94 cm), radical length (5.25 and 4.88 cm) and fresh weight of seedling (3.92 and 3.63g) as well as dry weight of seedling (0.07 and 0.06g) respectively. While the lowest values of germination% and quality parameters were observed in the third system due to environmental factors can contribute to seed vigor loss during different development stages whereas, the temperature decreases, and the humidity increases with the possibility of rain. In addition, these environmental conditions favor pathogen attack which may also contribute to seed deterioration through physical damage and biochemical degradation. These results substantiate those reported by (Grass 1995) on beans, found that, weathering caused disruption to cell membranes, while there was also evidence of changes in both lipid and protein bodies as well as loss of ribosome and impaired respiratory capacity. Moreover, germination percent may be not affected but seed vigor was significantly reduced. On the other hand, the different cutting systems were clearly affected on seed position on the mother plant and therefore, seed quality such as seed size, embryo size, germination and vigor are known to vary, depending on such factors as assimilate supply, photosynthetic activity, plant morphology, maturity and the micro-environment. These results are in agreement with those reported by (Hampton 1999).

Effect of K fertilizer applications

Data presented in same Tables 6 and 7 indicated that effect of K fertilizer treatment on germination % and most quality parameters. The statistical analysis for germination% and most quality parameters showed significant differences among the K fertilizer treatments. It is apparent from the data of the combined data, significantly higher for germination % and most quality parameters were recorded by apply of application K4 (50% K as soil application + K foliar spray at flowering and pod filling stages) while the lowest values of quality parameters were recorded by control (whitout fertilizer). The significant increase in shoot and radical length might be due to higher seed index as is reflected in the test weight of the seed, which might have supplied which you may have provided adequate food reserve of K for resumption fetal growth. These findings are supported by Kumar *et al*. (2011) who reported that in Niger seed quality parameters like germination percentage and seedling length were observed to be lower when the pod development stage was short and delayed.

Effect of cutting system and K fertilizer interaction

The interaction between each two factors under study proved to affect viability and quality of seeds. The most important of these interactions are shown in same Tables 6 and 7. It is evident from the data that germination%, seedling vigor index (1) and (2), shoot and radical lengths as well as fresh and dry weight seedlings were significantly decreased due to left plants and taken the seeds after twice cut under the different K fertilizer application. Thus, from the interaction between cutting system and K fertilizer applied it could be concluded that with twice cut system and deficit of K fertilizer especially to the developing seeds, seed quality attributes were adversely affected. Small fluctuations in the weather such as temperature showed higher variations in plant growth and development, which finally influenced on the quality parameters of cowpea seeds. These obtained data are similar to those obtained by El- Karamany *et al*. (2019) on mungbean.

Economic evaluation

Results in Table 8, clearly showed of the economy evaluation profitability of producing of seed. When leaving the plants after taking once cut as green fodder and applying treatment K4 of potassium fertilizer resulted in higher seeds yield of cowpea compared with others. The total variable cost ratio at farm was found as (7398L.E) and the total revenue calculated from total revenue for once cut and seed yields were found as (16945L.E) also the highest net return was (9547L.E.). Both the green fodder and seed as marketable commodities. Thus, if the farmers are able to sell the green fodder initially and subsequently the seed, they will be benefitted much more than the other treatments. It can be used by farmers to maximize the benefits of growing dual-purpose cowpea.

Conclusion

Studies presented in this paper define the importance of some basic agricultural practices to achieve the highest yield and quality of seeds as well as high returns of forage cowpea. It can be concluded that the one-time cutting system using K4 fertilizer application was an effective system for increasing the yield of seeds and their components, improving cowpea seeds as well as achieving the highest profit.

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Doi: 10.21608/ajas.2022.104794.1063
Hassan, et al., 2021 *http://ajas.journals.ekb.eg/*

تأثير نظم الحش والتطبيقات المختلفة للتسميد البوتاسي على إنتاجية التقاوي وجودتها في لوبيا العلف

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الملخص

أقيمت تجربتان حقليتان بمحطة بحوث الزراعية بكفر الحمام – التابعة لمركز البحوث الزراعية بمحافظة الشرقية، خلال الموسميين الصيفيين ٢٠١٨ و٢٠١٩ وتجربتان معمليتان بقسم بحوث محاصيل العلف وتكنولوجيا البذور – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية بالجيزة، وذلك بهدف دراسة تأثير ثلاثة نظم للحش (بدون حش، حشة واحدة وحشتين) وست معاملات من التسميد البوتاسي كإضافة أرضية والرش الورقي (بدون تسميد بوتاسي، ١٠٠% بو أرضي ، ٥٠% بو أرضي + بو ورقي عند مرحلة التزهير، ٥٠% بو ارضي + بو ورقي عند مرحلتي التزهير وامتلاء القرون ، ٢٥% بو ارضي + بو ورقي عند مرحلة التزهير ، ٢٥% بو ارضي+ بو ورقي عند مرحلتي التزهير وامتلاء القرون) على إنتاجية البذور وجودتها لمحصول لوبيا العلف ، ويمكن تلخيص أهم النتائج فيما يلي:

زادت إنتاجية البذور في نظامي بدون حش وبعد حشة مرة واحدة بشكل عام في ارتفاع النبات، عدد البذور/ النبات، عدد القرون/ النبات، طول القرن، وزن القرون/ النبات، وزن ١٠٠ بذرة ودليل الحصاد بالإضافة إلى محصول البذور، حيث بلغت الزيادة في نظامي الحش الأول والثاني مقارنة بنظام الحش الثالث في محصول البذور ٥٤,٥٦ و٤٤,٠٨٪ على التوالي. كما انخفضت نسبة الإنبات وطول الجذير والوزن الغض والجاف للبادرات وكذلك مؤشر قوة البادرات ١ و٢ من البذور التي تم الحصول عليها بعد حش لوبيا العلف مرتين على أساس بيانات متوسط الموسمين.

عموما كان لاضافة التسميد البوتاسي تأثير معنويا على مساهمات إنتاج البذور ما عدا ارتفاع النبات، حيث أدى تطبيق معاملة التسميد البوتاسي ٥٠٪ بوتاسيوم كإضافة أرضية + بوتاسيوم رش ورقي عند مرحلتي الإزهار وامتلاء القرون إلى زيادة محصول البذرة (كجم/ فدان) بنحو ٥٤.١٣٪ مقارنة بالكنترول من جهة ومن جهة أخرى، فإن استحدام نفس هذا التطبيق كان فعالا في إنتاج بذورا أعلى حيوية وقوة مقارنة بالكنترول وذلك على اساس متوسط الموسمين

اعطى نظامي الحش وهما ترك النباتات واخذ البذور بدون حش أو أخذ البذور بعد حشها مرة واحدة مع استخدام تطبيق ٥٠٪ بوتاسيوم كإضافة ارضية + بوتاسيوم كرش ورقي في مرحلتي الإزهار وامتلاء القرون أعلى محصول بذور/ فدان (٦٤٩.٠١ و٦١٧.٤٧ كجم) على التوالي. كما أدى ذلك إلى تحسين معظم معايير الجودة مقارنة مع المعاملات الأخرى.

وفقا لنتائج الدراسة الحالية، فقد سجل أعلى صافي عائد لكل جنيه مستثمر (٢,٢٩جـ). يمكن للمزارعين الحصول على نفس محصول اللوبيا إذا قاموا بالحش مرة واحدة وتطبيق المعاملة التسميد البوتاسي بنسبة ٥٠٪ بوتاسيوم كإضافة أرضية + بوتاسيوم كرش ورقي عند مرحلتي التزهير وامتلاء القرون. وبهذه الطريقة يمكننا أخذ حشة واحدة كعلف أخضر الذي يساهم في سد فجوة العلف خلال أشهر الصيف ومن جهة أخرى، تقليل ضرر الأسمدة البوتاسية الباهظة والمضافة ارضيا واستبدالها بأسمدة الرش الورقية التي تساعد على خفض تلوث البيئة بالإضافة إلى الأهداف الأساسية لإنتاج بذور أفضل كمية ونوعية وبأقل تكلفة من حيث الناتج.

ومن هنا، يوصى بأخذ محصول التقاوي من لوبيا العلف بعد حشها مرة واحدة وتطبيق معاملة التسميد البوتاسي ٥٠٪ كإضافة أرضية + بوتاسيوم كرش ورقي في مرحلتي التزهير وامتلاء القرون، حيث يمكن تحقيق أعلى محصول تقاوي وكذلك فيما يتعلق بمقاييس جودة اللوبيا وعائد مرتفع.