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(Original Article)

Effect of Planting and Weed Control Methods on Yield and its Attributes of Egyptian Cotton (Giza 90 cultivar)

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Abstract

A field experiment was conducted during the 2019 and 2020 seasons to investigate the influence of different weed management treatments namely; Butralin as pre-emergence herbicide (2.5 L/fed.), butralin (2.5 L/ fed.) + hoeing once at one month after planting (DAP), hand hoeing thrice at 15, 30 and 45 DAP and un-weeded treatment under different planting methods, i.e., rows and raised beds planting, on weeds density, yield and its attributes of cotton cultivar Giza 90. Results indicated that weeds density was decreased significantly with all studied weed control methods compared with un-weeded treatment(control) in both seasons. In addition, the plant height, sympodial branches number, opening bolls number, boll weight and cotton yield were also increased with all studied weed management treatments over no-weed treatment. Also, hand hoeing thrice during the growing season gave higher values for seed cotton yield as compared to the other studied weed control treatments in the two grown seasons. Furthermore, the obtained result showed that among the tested planting methods, beds width 120cm planting gave the highest results in terms of controlling weeds, decreasing weeds dry weight, increasing number of sympodial branches plant^{-1}, total number of opening bolls plant^{-1}, boll weight and seed cotton yield. The interaction between planting methods and weed control methods was significant in its effect on all studied traits. The interaction showed that applying hand hoeing thrice in beds with planting width 120 cm led to a reduction in the dry weight of total weeds either broad or grassy weeds, giving the best results for sympodial branches number, total number of opening bolls, weight of boll and seed cotton yield.

Keywords: *Cotton, Planting methods, Weed control, Yield.*

Introduction

Cotton is one of the important crops in Egypt and it's considered a significant source of fibers due to its high long staple fiber. In recent years, cotton cultivated area decreased in Egypt as a result of increased associated problems of cotton planting such as the spread of weeds and pests, where the area reached to 231000 and 183000 fed. in 2019 and 2020 seasons, respectively and the average of seed

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cotton yield was 8 kentar/fed. (FAO, 2020). Weeds are a major factor limiting the production of cotton in Egypt. In this regarding, (Oerke, 2006) reported that cotton can be losing a lot of it crop if attacked by viruses, pathogens disease, insect pests and weeds. Weeds can compete cotton plants for light and nutrients as well as more water absorbing and consuming by weeds, ultimately the yields are decreased significantly (Berger *et al*., 2015 and Nalini *et al*., 2015). Mechanical control is a common method in weed management of cotton crop, as well as chemical weed control. Tunio *et al*. (2003) showed that the treatments included pre-emergence herbicides significantly reducing the weeds germination and increased the open bolls number and seed yield of cotton as compared with un-weeded treatment. Anaam *et al*. (2020), reported that, hand hoeing twice had the lowest value in total weeds dry weight, followed by treatments of pre- emergence herbicides comparing with control in two growing seasons. Also, Khan and Khan (2003), declared that cotton hand hoeing recorded the highest seed cotton yield due to decrease the weed density, as compared with chemical weed control. Nadeem *et al*. (2013) found that yield components such as sympodial branches plant^{-1}, opening bolls plant^{-1}, seed weight plant^{-1} and seed cotton yield were increased with all weed control practices compared with un-weed treatment.

On the other hand, because weeds are sometimes resistant to herbicides, the chemical weed control treatments may not be feasible or effective. Therefore, allelopathy uses have also been found effective in repressing the weeds growth in cotton. Many allelopathy forms are used to contribute weed control in cotton crop such as intercropping, raised and wide beds, and spacing between rows. Weeds growth behavior may also differ under different planting methods. In this regard, Kumar *et al*. (2006) indicated that raised bed planting caused a significant reduction in the density of weed species, the minimum total weed count and dry matter were recorded with raised bed planting. Binish Khan *et al*. (2021) found that both total weeds density either grassy weeds or broad weeds were influenced by different planting methods and planting density of cotton in both years of experimentation, and the lowest numbers of weeds were recorded in ridge and bed planting method compared to the flat sowing. Nadeem *et al*. (2013) concluded that the ridge planting method decreased the weeds density significantly as compared to flat planting method due to changing the formation of land from flat to ridges and beds where some of the weed seeds were exposed. All weeds control practices may be combined to achieve sustainable weed control in cotton leading to improve weed management and increasing the productivity of cotton. Maqbool *et al*. (2001), noted that the increase in weed numbers in flat planting method could be explained because the weed seeds are present homogenously at soil surface while in ridge and bed planting methods seeds might be confined to the specific area due to the change of micro-topography in ridge and bed formation. Regarding yield and its attributes traits, Abd El-Moneim *et al*. (2017) reported that planting cotton on wide ridge in 2 sides (beds) led to short the plant height during the both seasons than the rows planting. Here too, Ghoprial *et al*. (2021) showed that No. of open bolls per plant, boll weight and seed cotton yield/ fed were significantly affected by planting methods in the both seasons and the highest values were in favor of

the wide beds. Also, Binish Khan *et al*. (2021) indicated that beds planting method of cotton increased the sympodial branches, opened bolls per plant, boll weight and seed cotton yield as compared to flat and ridge planting methods.

In light of the above, the aim of this investigation was to determine the best treatments among weed control methods to minimize the bad effects of associated weeds and increase cotton yield under different sowing methods.

Materials and Methods

Awo field experiment was conducted at Agricultural Research Center, Shandaweel Station, Sohag governorate during the seasons of 2019 and 2020. This study aims to investigate the performance of four weed control treatments as follows:

Butralin spraying (Table: 1) as pre-emergence herbicide at rate 2.5 L/fed.

Butralin spraying as pre-emergence herbicide at rate 2.5 L/fed followed by one hand hoeing at 30 days after planting (DAP).

Hand hoeing thrice at 15, 30 and 45 days from planting day (DAP).

Un-weeded check (control)

Under three methods of cotton planting i.e., raised rows planting (12 row / qsibtayn 60 cm between rows as conventional planting) and raised bed planting as beds width 90 cm and beds width 120 cm, on the associated weeds, cotton yield and its attributes. Giza 90 cotton variety was sown on 30 th of March in 2019 and 2020 seasons, respectively. The studied treatments were arranged in a strip plot arrangement with three replications in a randomized complete block design (RCBD), with plot area size 12 m^2 where the planting methods were allotted vertically while the weed treatments were arranged horizontally. Amex (Butralin applying) Herbicide was sprayed at water volume of 200 L/fed. All the recommended agricultural practices were applied throughout the growing seasons. The soil analyses at the experimental site are shown in Table 1, Chapman and Pratt (1978). Data sheet of the user herbicide is shown in Table 2.

Table 1. Analyses of the soil at the experimental site during 2019 and 2020 seasons

Properties	Seasons	
	2019	**2020**
Sand %	20 %	19%
Silty %	47%	50%
Clay %	33%	31%
Soil texture	Clay Loam	Clay Loam
pH	7.46	7.70
Organic matter %	1.88	1.78
$CaCo_3$ %	2.35	2.70
EC ds/m	1.28	1.40
Total N %	0.89	0.97

Table 2. Common, trade and chemical name of used herbicide

Common name	Trade name	Group	Chemical name	Mode of action
Butralin	Amex 48%EC	Dinitroaniline	N-butan 2,6--dinitroaniline 2-yl-4-tert-butyl-	Microtubul Inhibition e assembly

Studied Traits

1- Weeds survey

Herbicide during two seasons was sprayed by Cp3 in water volume 200 liters/fad. Weeds were pulled by hand from one square meter selected randomly in each plot after 60 (DAP) and classified into three groups according as follows:

A. Grassy weeds (g/m^2).

B. Broad-leaved weeds (g/m^2).

C. Total weeds: the sum of broad and grassy weeds (g/m^2).

The dry weight of the samples to each group was recorded after air drying for 72 hours and oven dried at 70 ºC for 24 hours even with weight stability.

2- Yield and its attributes traits

Random samples of six plants were chosen from each plot, in order to study the following traits

- Plant height (cm.) at harvest.
- Number of sympodial branches $plant^{-1}$.
- Number of opening bolls $plant^{-1}$.
- Boll weight (gm).
- Seed cotton yield /fed in kentars: (one kentar seed cotton=157.5 kg).

Statistical analysis

All collected data was arranged and performed for analysis of variance using SAS software version 9.2 (SAS 2008)'s Proc Mixed, and the obtained means were compared using revised Least Significant Difference (RLSD) at 5% and 1% levels of significance (Snedecor and Cochran, 1981).

Results and Discussion

Table 3. Scientific names, English names and families of weeds associated with cotton crop in the experimental site at Shandaweel Research Station during 2019 and 2020 seasons.

Weeds type	Scientific name	English name	Family
Broad-leaved weeds	*Xanthium spinosum* L	Spiny cocklebur	Asteraceae
	Convolvulus arvensis L.	bindweed	Convolvulaceae
	Amaranthus hybridus L.	Pigweed	Amaranthaceae
	Datura stramonium L.	Jimsonweed	Solanaceae
Grassy weeds	*Echinochloacolonum*L.	Jungle rice	Poaceae

Planting methods effect

Data recorded in Tables 4 to 11 reveal a significant difference between lines method and beds method in planting of cotton in all studied traits except the results of grassy dry weeds weight which was non-significantly affected by studied planting methods in both growing seasons. Thus, beds method produced the higher mean values in this respect than the lines method for all studied trait in both seasons. It can be observed that beds planting method gave higher average values for number of sympodial branches plant^{-1}, opening bolls plant^{-1}, boll weight and seed cotton yield as shown in Tables 8 to 11. Also, the reversible trend was shown as for plant height and dry weight of broad, grassy and total weeds after 60 days from planting in the two growing seasons, where's data showed increasing these traits in favor of lines planting method in 2019 and 2020 seasons (Tables 4 to 7). Here too, data indicated superiority the values of these traits in case of planting in beds 120cm width than planting in beds 90 cm width. These results were in agreement with those reported by Kumar *et al* (2006), Nadeem *et al*. (2013), Shaheen (2017), Abd El-Moneim *et al*. (2017), Ghoprial *et al*. (2021) and Binish Khan *et al*. (2021). They indicated that raised beds planting caused significant reduction in the density of weed species. During their studies the minimum total weed count and dry matter recorded in raised bed planting as happens in this study. Decreased in grassy, broad and total weeds dry weight in beds planting methods may be due to less water reaching the area above the bed, which led to reduce the seed germination of the weeds. Here too, planting methods changed the land formation from line to bed shape, which effected in some of the weed seeds exposed as a reason for micro-topography alteration in the formation of bed (Maqbool *et al*., 2001).

Also, it should be noted that sowing in beds was in the ridges of the both sides, that available a horizontal space above the beds which allowed better light penetration in the canopy to the lower leaves, good ventilation and less water reaching the area above the beds, those reasons led to reduce the competition between plants for light and nutrient and plants grew shorter in respect of vertical space. The other traits of the crop component as number of opening bolls, boll weight and the seed cotton yield were increased.

Weed control effects

It's clear from the obtained data in the same previous Tables that all studied weed control treatments recorded a significant ($p \leq 0.05$) reduction in Weeds associated with the cotton crop compared to un-weeded treatment in both seasons in favor of hand hoeing thrice (Tables 4 to 6). Regarding the yield traits, the weed management treatments had a significant impact on all these mentioned traits. The manual hoeing thrice treatment recorded the highest average values for plant high, Number of fruiting branches plant^{-1}, opening bolls plant^{-1}, boll weight and seed cotton yield compared with the other studied weeds control treatments, followed by Amex + hand hoeing once treatment, followed by the results of applying Amex spray alone (pre-emergence herbicide). While the lowest average values in this respect were recorded in un-weeded treatment in both seasons (Tables 7 to 11).

It is proven fact that weed compete for space, light, water and nutrient with the crop and hinder growth of the same. If weeds are taken away by weed control methods, the direction will be changed and the crop growth gain height as well as more branches per plant. So, Khan and Khan (2003) declared that cotton hand hoeing recorded the lowest weed density and the highest seed cotton yield, as compared with chemical weed control. Here too, Nadeem *et al*. (2013) found that cotton traits such as fruiting branches, mature bolls and seed weight were increased with all weed control practices over weedy check, which led to an increase in the seed cotton yield.

Interaction effects

Data presented in Tables 4 to 11 illustrate the impact of interaction between planting methods and weed control treatments. The interaction effect was significant on dry weight of broad and total weeds in 2019/2020 while the interaction was significant in the first season only in its effect on grassy weeds dry weight in both seasons. Hand hoeing thrice in beds 120cm width planting method recorded the lowest mean values of dry weight to broad, grassy and total weeds in the two growing seasons as compared to other studied treatments combination. The effect of interaction between weed control and planting methods on plant height in 2019/2020 was significant. Applying hand hoeing thrice on beds planting method recorded the highest average values of sympodial branches number plant^{-1}, number of opening bolls plant-1, boll weight and seed cotton yield. These results are respected since hands hoeing in beds planting succeeds in reducing the dry weeds weight.

Table 4. Means of dry weight of broad-leaved weeds (g/m2) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	343.55	100.55	40.66	483.55	242.08	298.11	110.33	37.22	500.11	236.44
Beds width 90cm	338.33	79.44	27.00	345.55	197.60	283.44	75.77	22.00	315.22	174.11
Beds width 120cm	325.22	47.88	25.44	338.33	184.22	288.89	42.44	19.22	325.00	168.88
Mean	335.70	75.96	31.03	389.14	---------	290.15	76.18	26.14	380.11	---------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		12.70			**		15.31	
W		**		16.60			**		18.76	
P× W		**		23.30			**		22.86	

Where ** mean significant at 1 % levels of probability.

Table 5. Means of dry weight of grassy-leaved weeds (g/m^2) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	96.22	29.00	9.22	235.00	92.36	81.00	15.89	9.00	142.00	61.97
Beds width 90cm	98.60	32.45	10.00	207.20	87.06	75.55	12.55	9.11	141.44	59.67
Beds width 120cm	100.40	30.48	8.67	208.00	86.88	73.66	10.44	7.78	132.00	55.97
Mean	98.40	30.65	9.30	216.73	--------	76.74	12.96	8.63	138.48	--------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		N.S		--------			N.S		-------	
W		**		4.95			**		9.60	
P× W		**		6.15			N.S		-------	

Where N.S and ** mean non-significant and significant at 1 % levels of probability, respectively.

Table 6. Means of dry weight of total weeds (g/m2) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	439.77	129.55	49.88	718.55	334.44	379.11	126.22	46.22	642.11	298.41
Beds width 90cm	436.92	111.89	37.00	552.78	284.65	359.00	88.33	31.11	456.66	233.77
Beds width 120cm	425.63	78.37	34.11	546.29	271.10	362.55	52.89	27.00	457.00	224.86
Mean	434.11	106.60	40.33	605.87	---------	367.00	89.15	34.77	518.60	---------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		10.83			**		16.83	
W		**		17.04			**		19.30	
P× W		**		22.52			**		28.13	

Where ** mean significant at 1 % levels of probability.

Table 7. Means of Plant height (cm) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	128.0	139.6	158.7	95.0	130.3	123.7	132.0	149.8	96.6	125.5
Beds width 90cm	124.1	138.3	147.7	89.1	124.8	108.8	135.0	147.6	83.8	118.8
Beds width 120cm	115.0	124.1	142.8	82.0	116.0	107.5	125.2	130.4	84.6	112.0
Mean	122.4	134.0	149.7	88.7	--------	113.3	130.7	142.6	88.3	---------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		0.9			**		1.1	
W		**		1.0			**		1.4	
P× W		**		1.5			**		1.0	

Where ** mean significant at 1 % levels of probability.

Table 8. Means of No. of sympodial branches as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	10.0	13.2	14.3	6.4	11.0	11.3	13.5	17.8	7.2	12.4
Beds width 90cm	10.7	13.3	16.7	7.6	12.1	11.9	14.3	17.2	7.6	12.8
Beds width 120cm	10.7	15.0	16.6	7.9	12.5	12.2	14.0	18.0	7.7	13.0
Mean	10.5	13.9	15.9	7.3	--------	11.8	14.0	17.7	7.5	--------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		0.2			**		0.2	
W		**		0.3			**		0.3	
P× W		**		0.5			**		0.4	

Where ** mean significant at 1 % levels of probability.

Table 9. Means of No. of opening bolls as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	6.0	8.3	14.9	3.0	8.1	5.4	7.5	11.8	4.4	7.3
Beds width 90cm	7.1	9.9	14.7	4.9	9.2	7.9	10.4	13.9	6.1	9.6
Beds width 120cm	7.5	12.1	17.1	5.5	10.5	10.3	15.0	17.6	8.0	12.7
Mean	6.8	10.1	15.6	4.5	---------	7.9	11.0	14.5	6.2	--------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		0.2			**		0.5	
W		**		0.4			**		0.7	
P× W		**		0.8			*		1.2	

Where * and ** mean significant at 5 and 1 % levels of probability, respectively.

Table 10. Means of Boll weight (gm) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	1.750	1.86.2	2.180	1.732	1.881	1.753	1.873	2.127	1.720	1.868
Beds width 90cm	1.873	2.013	2.203	1.780	1.968	1.873	2.023	2.243	1.780	1.980
Beds width 120cm	1.923	2.273	2.250	1.767	2.053	1.933	2.263	2.273	1.817	2.072
Mean	1.849	2.050	2.211	1.760	--------	1.853	2.053	2.214	1.772	---------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		0.073			**		0.020	
W		**		0.056			**		0.063	
P× W		**		0.098			*		0.106	

Where * and ** mean significant at 5 and 1 % levels of probability, respectively.

Table 11. Means of Seed cotton yield / fed (Ken) as affected by planting methods, weed control and their interaction in 2019 and 2020 seasons

Seasons	2019					2020				
Weed control (W) / Planting methods (P)	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean	Amex	Amex + hand hoeing once	Hand hoeing thrice	Un-treated	Mean
Lines width 60 cm	3.16	5.48	7.00	1.76	4.35	4.47	6.31	7.44	1.90	5.03
Beds width 90cm	5.28	7.40	8.43	2.32	5.85	5.87	7.95	9.00	3.15	6.49
Beds width 120cm	5.95	8.11	9.17	2.93	6.54	6.51	8.70	9.54	3.63	7.10
Mean	4.80	7.00	8.20	2.34	---------	5.62	7.65	8.65	2.90	--------
F test and R.L.S.D. 0,05		F test		R.L.S.D. 0,05			F test		R.L.S.D. 0,05	
P		**		0.192			**		0.133	
W		**		0.14			**		0.13	
P× W		**		0.22			**		0.11	

Where ** mean significant at 1 % levels of probability.

Conclusion

It may be concluded that hand hoeing thrice in beds planting width 120 cm resulted in decreased the dry weight of weeds and increased the yield of cotton and its components.

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تأثير طرق الزراعة ومقاومه الحشائش على محصول القطن المصري وصفاته

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الملخص

تم اجراء تجربه حقليه في محطه البحوث الزراعية بجزيره شـــندويل– ســـوهاج والتابعة لمركز البحوث الزراعية خلال موســـمي الصـــيف 2019 و2020 م لبحث تأثير اربع معاملات لمكافحة الحشائش المختلفة في القطن (الرش بماده بوترالين كمبيد أعشاب سابق للظهور (2.5 لتر / فدان) ، الرش بماده بوترالين (2.5 لتر / فدان) بالإضـافة الي اجراء عزيق يدوي مرة واحدة بعد 30 يومًا من زراعه القطن، العزيق اليدوي ثلاث مرات وبدون معامله) وذلك تحت ثلاث طرق للزراعة (زراعة خطوط بعرض 60 ســم بين الخط والاخر ، زراعه مصـــاطب بعرض 90 ســم وزراعه مصاطب بعرض 120سم)على كثافة الحشائش والمحصول وصفاتها لصنف قطن جيزة

أعطت جميع حزم مكافحة الحشـــائش انخفاض معنوي لجميع أنواع الحشـــائش (عريضـــة وضيقة الاوراق والكلية) مقارنة بالمعاملة الكنترول وظهر زيادة معنوية في جميع صفات مكونات المحصول خلال موسمي الزراعة .حيث وجد زيادة ارتفاع النبات، عدد الأفرع الثمرية، عدد اللوز المتفتح على النبات، وزن اللوزة ومحصـــول القطن الزهر للفدان مع جميع ممارســـات مكافحة الحشائش بالمقارنة بالقطاعات الغير معامله (الكنترول). نتج عن العزيق اليدوي ثلاث مرات أعلى محصـــول قطن زهر في الفدان. ومن بين طرق الزراعة، أعطت المصـــاطب بعرض 120 ســـم أفضـل النتائج من حيث تأثيرها على مكافحة الحشـائش، وتقليلها للوزن الجاف للحشـائش، كما وجد في زراعه المصاطب زيادة معنويه في عدد الأفرع الثمرية لكل نبات، وإجمالي عدد اللوز المتفتح، وزن اللوزة، ومحصـــول القطن الزهر للفدان. كما كان التفاعل بين طرق الزراعة وطرق مكافحة الحشائش معنوياً في تأثيره على جميع الصفات المدروسة وتم الحصول علي اعلي محصول للقطن الزهر في الفدان من تطبيق العزيق اليدوي ثلاث مرات خلال الموســـم في طريقه الزراعة على مصاطب بعرض 120سم.