

# INTEGRATED EFFECT OF VARIETIES, PLANT DENSITY AND WEED CONTROL TREATMENTS ON CHEMICAL COMPOSITION AND YIELD OF SOYBEAN GROWN IN NEWLY RECLAIMED SOIL

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## ABSTRACT

The effects of Butralin herbicide (2.5 L/fed), H<sub>2</sub> and manual hoeing twice, H<sub>3</sub> (at 30 and 60 days age) together with three hill spacing (10 (D<sub>1</sub>), 15 (D<sub>2</sub>) and 20 (D<sub>3</sub>) cm between hills) on vegetative growth, chemical composition, yield and yield components and quality traits of two soybean cvs (Giza 111, V<sub>1</sub> and Giza 21, V<sub>2</sub>) and associated weeds, were of interest of the present work. The study was carried out, through split split-plot design at experimental farm of the Fac. of Agric., Fayoum univ., during 2006 and 2007 seasons. The results showed that both Butralin herbicide (H<sub>2</sub>) and manual hoeing (H<sub>3</sub>) weed treatments surpassed the unweeded one (H<sub>1</sub>) in controlling weeds in soybean field. Suppression ratios of weed growth due to manual hoeing (71.3 to 76.3%) for broad (BFW), narrow (NFW) leaved and total weeds were higher than that of Butralin (62.5%) for only narrow leaved weeds. Hill spacing significantly affected BFW and total weed weight in the first sample in favor to the closest spacing (D<sub>1</sub>) which resulted in 30.3 and 36.2% weed excision, respectively, over the widen spacing (D<sub>3</sub>). The results indicated that hill spacing had lower effect than weed control treatment on weed growth. There was no significant effect of soybean varieties on weed growth. H<sub>2</sub> D<sub>2</sub> V<sub>2</sub> and/or H<sub>3</sub> D<sub>1</sub> V<sub>2</sub> exhibited the lowest NFW. In respect to chemical constituents of soybean plants, H<sub>2</sub> and H<sub>3</sub> markedly exceeded H<sub>1</sub> treatment, in favour to H<sub>2</sub> for most estimates, with similar values for phenols, carotenoids and anthocyanin with those of H<sub>3</sub>. Hill spacing showed overlapping effect on chemical constituents, in favour to the intermediate plant density D<sub>2</sub> (15 cm) and/or D<sub>1</sub> (10 cm). H<sub>2</sub> D<sub>3</sub>, H<sub>2</sub> D<sub>2</sub>, H<sub>3</sub> V<sub>2</sub> as dual interaction as well as H<sub>2</sub> D<sub>3</sub> V<sub>2</sub>, H<sub>3</sub> D<sub>1</sub> V<sub>1</sub> and H<sub>2</sub> D<sub>2</sub> V<sub>1</sub> as trio-interactions were of great positive effects on chemical constituents of soybean plants. Regarding yield and its components, H<sub>3</sub> treatment produced highest values for yield and its components, while H<sub>2</sub> increased vegetatively, i.e. plant height. Narrow spacing (D<sub>1</sub>) increased numbers of branches and pods and weight of pods, plant seeds and seed yield/fed. Intermediate plant density gave branches and seed yield/fed similar to those of D<sub>1</sub>. V<sub>2</sub> outweighed V<sub>1</sub> in yield and its components where is the reverse was true for plant height. Positively effective interactions were H<sub>3</sub> D<sub>1</sub>, H<sub>2</sub> V<sub>2</sub> and H<sub>3</sub> D<sub>1</sub> V<sub>2</sub>, on weights of pods, number of seeds/plant and seed index. The highest percentages of carbohydrates (23.73), protein (48.10) and oil (22.38%) were recorded by H<sub>3</sub> D<sub>3</sub> V<sub>1</sub>, H<sub>2</sub> D<sub>1</sub> V<sub>1</sub> and H<sub>2</sub> D<sub>3</sub> V<sub>1</sub>, respectively. The absolutely highest seed yield/fed (1.89) in such newly reclaimed land was obtained by Giza 21 (V<sub>2</sub>) planted in closest hill spacing D<sub>1</sub> (10 cm, 2 plants/hill) and treated by manual hoeing twice.

**Key words:** Varieties, Plant density, Weed control, Chemical composition, Yield.

## INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is a worldwide legume crop grown commercially in over 35 countries located in between 10 and 50° latitudes. The wide expansion of the crop is due mainly to its advantages as food and feed. Soybean seeds, contain about 40% protein and 20% oil, provide approximately 60% of the world supply of vegetable protein and 30% of the oil (Fehr, 1990). It is also used in the formation of various industrial human diets and concentrated animal feed. In addition to its merit in improving soil fertility by fixing atmospheric nitrogen. Despite, the crop acreage and production in Egypt are limited and currently diminished owing to its lower benefit than the other competitive summer crops occupied the old land in Nile Valley and Delta. So, growing soybean in new ameliorate soils is imperative and ineludible for raising its national production, particularly if cultivated under complementary suitable combination of agriculture factors such as varieties, plant density and weed control treatments.

Weeds occurrence in soybean field cause great losses in yield, thereby various mechanical and chemical weed control treatments were investigated. Muniyabba *et al* (1982) and Joshi and Billore (1998) suggested that weed control is essential especially during the early development of soybean. Lakers *et al* (1987) and Dubey (1998) reported that manual weeding was more effective weed control than any herbicide and increased seed yield. Whereas, Hassanein *et al* (2000) showed that some herbicide (i.e., pendimethalin, oxyurlen and linuzon, in combination of betrazone) were effective and comparable to hand weeding from the point of weed control and soybean yield. Both hand weeding and pendimethalin treatments, tested by Galal (2003) significantly decreased the dry weight of broad and narrow leaved weeds than unweeded treatment, but hand weeding gave the lowest dry weight of total weeds. Manjusha *et al* (2004) and Umale *et al* (2005) reported that the favourable effect of weed suppression, fully reflected in improved yield and its components, was obtained with two hoeing and one hand weeding. Keramati *et al* (2008) stated that it is possible to optimize the timing of weed control, between second trifoliolate and beginning bloom or first flower, which can serve to reduce the costs and side effect of intensive chemical weed control.

Virtually, soybean produces better when it is spaced in adequate geometry resulted in full cover of entire soil surface, encountered solar radiation, during its seed development period (Taylor, 1980). Where the greatest seed yield may be obtained from greater light interception and conversion of solar energy into dry matter production before seed initiation (Duncan, 1986). Several soybean investigators suggested that plant spacing greatly affected both vegetative growth and reproductive traits and the closer plant spacing decreased some yield components, whereas, the total seed yield/unit area was increased (Wells, 1991; Dubey, 1998; Ball *et al*, 2000 Veeramani *et al* 2001 and Galal, 2003). However, the favorable plant densities were varied according to spacing between rows (20 to 70 cm) and /or within row (5 to 30 cm), cultural practices, production area, soil fertility and used varieties.

Therefore, the present work was designed to study the integrated effect of plant spacings, weed control treatments and varieties on growth, chemical composition, yield and yield components of soybean and associated weeds under the conditions of newly reclaimed soil of Fayoum Governorate.

## MATERIALS AND METHODS

The present investigation was carried out at the experimental Demo Station farm of the faculty of Agriculture, Fayoum University, during 2006 and 2007 summer season. The work objective was to study the individual and integrated effects of weed control treatments, hill spacing and varieties on vegetative chemical composition, seed yield and its components and quality traits of soybean and associated weeds. Field soil was loamy sand texture in both seasons, characterized by ECe of 4.56 and 4.2 dS/m, pH of 8.07 and 8.2, CaCO<sub>3</sub> of 15.04 and 14.88% and organic matter of 0.89 and 0.74% in the first and second season, respectively. The weed control treatments were (1) unweed or control (H<sub>1</sub>), (2) Butralin [Amex 48% EC, 4-(1,1-dimethylethyl)-N-(1-methylepropyl)-2,6-dinitrobenzenamine] at 2.5 L/feddan (H<sub>2</sub>) applied pre-sowing and (3) manual hoeing treatment (H<sub>3</sub>) done twice, after 30 and 60 days from sowing. Also, three hill spacing treatments were practiced, i.e. 10 (D<sub>1</sub>), 15 (D<sub>2</sub>) and 20 cm (D<sub>3</sub>) between hills with two plants per hill after complete emergence. Two soybean varieties, i.e. Giza 111 (V<sub>1</sub>) and Giza 21 (V<sub>2</sub>) were used. A split-split plot design with three replications was used, where the weed control treatments, hill spacing and varieties were arranged in main-, sub- and sub-sub plots, respectively. The plot area was 10.5m<sup>2</sup> (3x3.5 m) each plot consist of 5 rows, 60 cm apart and 3.5m long.

Immediately before sowing, soybean seeds were treated with *Rizobium japonicum*. Sowing dates were on May 14 and 13 in the first and second seasons, respectively. Calcium super phosphate (15.5% P<sub>2</sub>O<sub>5</sub>) was applied before sowing at a rate of 150 kg/fed. Nitrogen fertilizer in the form of ammonium nitrate (33.5%N) was added at a rate of 60 kg/fed in three equal doses at planting, before the first and second irrigation. Weeds survey done during growth period, were hand pulled from one square meter in each plot after 45 and 90 days from sowing and classified into narrow (NFW), broad-leaved (BFW) and total weeds (Total W.) and then their fresh weights were determined. Also during the growth stage, two leaves samples were randomly taken from each plot after 40 and 65 days from sowing to estimate the chemical composition using either fresh (F.W) or dry weight (D.W). Total indols (mg/g D.W) after **Larson et al (1968)** and total free amino acids (mg/g, D.W) according to **Jayarman (1981)** were also determined. Total chlorophyll (g/g, F.W) as well as total carotenoids concentration (mg/g, F.W) were estimated using the method described by **Welburn and lichtenthaler (1984)**. Total sugars (mg/g, D.W.) and free phenols (mg/g, D.W) as well as anthocyanin concentration (mg/100g D.W) were determined according to the methods described by **Hoagland (1980)**.

At harvesting time, a random sample of ten soybean plants was taken from each plot to record the individual plant traits, i.e. plant height (Pl.H., cm), number of branches/plant (Brs/pl), number of pods (Pods/pl), weight of pods/plant (Pods Wt./pl, g.), weight of seeds/plant (S. Wt/pl., g) and 100-seed weight (S.I, g). Seed yield/fed (S.y/fed, t), was calculated on seed yield/plot basis. Seed protein content (Prot.%) determined by estimating nitrogen% and multiplying it by a factor of 6.25, total soluble carbohydrates (Carbo.%) in seed oil percentage (Oil%) were determined according to the **A.O.A.C. (1990)**.

Combined analysis of the obtained data was performed for the two seasons, according to **Gomez and Gomez (1984)**, where the Bartlet test of

homogeneity for errors indicated that the variance of data of both seasons was insignificant. Comparisons of means were done using LSD at 5% level.

## RESULTS AND DISCUSSION

The results showed, that soybean could be successfully grown in such new ameliorative soil even it tend to be calcorious, but its productivity differed depending upon empirical cultural factors and their combinations. The following discussion of the obtained results are concerned with weed and chemical composition of soybean plant during the vegetative growth stage as well as final seed yield and its components of the crop.

### a) Vegetative growth stage:

#### 1. Effect on weeds:

Weeds presented in the experimental fields were: *Chenopodium album*, *Common lambsquarters*, *Cyperus longus* L., *Echinochloa colonum* L., *Portulaca oleracea* L. *Amaranthus ascendens*, *Cynodon dactylon* L. Weed control practices significantly affected both fresh weight broad (BFW) and narrow (NFW) leaves and their total weeds in the two vegetative samples (Table1). Compared to the unweed treatment, both chemical and mechanical weed control ones were superior. Application of manual hoeing ( $H_3$ ) resulted in lightest weight of BFW (327.47) and total weeds (372.58 g/m<sup>2</sup>) in the first sample as well as BFW (364.07), NFW (60.08) and total weeds (424.15 g/m<sup>2</sup>) in the second older sample. Relative to the corresponding weight of unweeded treatment,  $H_3$  caused weed excision ratios of 72.5 and 71.3% in the first sample, and 76.3, 62.3 and 75.0% in the second one, respectively. However, Butralin treatment resulted in lowest weight of NFW (39.46 g/m<sup>2</sup>) in the first sample causing a weed reduction ratio of 62.5% relative to unweeded treatment. These results indicated that manual hoeing, especially during the two experimental growth stages was more effective in controlling both BFW and NFW than Butralin herbicide. Similar findings were previously obtained by Laker *et al* (1987), Dubey (1998), Joshi and Billore (1998), Galal (2003), Idapuganti *et al* (2005) and Silva (2008). However, Hassanien *et al* (2000) found that all chemical herbicides, used were effective and comparable to hand hoeing from point of weed control and soybean yield.

Hill spacing, as another main factor, pronounced affected BFW and total weeds in the first sample, whereas the differences did not reach significance level in the second one (Table1). Closed hill spacing ( $D_1$ ) prevented a considerable proportion of weeds to alive, where it associated with lowest weight of BFW (585.44 g/m<sup>2</sup>, with significant difference with that of  $D_2$ ) and total weeds (654.69 g/m<sup>2</sup>) of the first sample. These two finding represented 69.7 and 63.8% of the corresponding weed weight associated with the widest hill spacing ( $D_3$ ). Dubey *et al* (1998) and Galal (2003) revealed that closer plant spacing reduced weed production and its dry matter, whereas, Pandya *et al* (2005) reported that crop geometry failed to affect the dry matter of weeds and crop yield. The present findings, in other words, showed that the absolute elimination ratios of BFW and total weeds due to  $D_1$  were 30.3 and 36.2%, respectively. These results indicated that

Table 1. Combined interaction effects of weed control treatments (H), plant density (D) and varieties (V) on broad, narrow fresh weight and total fresh weight (BFW & NFW & Total W.) in g/m<sup>2</sup> at 45 and 90 day after sowing.

| Fac. (H)       | Fac. (D)       | Sample (1)     |                |         |                |                |        |                |                |         | Sample (2)     |                |         |                |                |        |                |                |         |
|----------------|----------------|----------------|----------------|---------|----------------|----------------|--------|----------------|----------------|---------|----------------|----------------|---------|----------------|----------------|--------|----------------|----------------|---------|
|                |                | BFW            |                |         | NFW            |                |        | Total W.       |                |         | BFW            |                |         | NFW            |                |        | Total W.       |                |         |
|                |                | V <sub>1</sub> | V <sub>2</sub> | Mean    | V <sub>1</sub> | V <sub>2</sub> | Mean   | V <sub>1</sub> | V <sub>2</sub> | Mean    | V <sub>1</sub> | V <sub>2</sub> | Mean    | V <sub>1</sub> | V <sub>2</sub> | Mean   | V <sub>1</sub> | V <sub>2</sub> | Mean    |
| H <sub>1</sub> | D <sub>1</sub> | 844.83         | 882.33         | 863.58  | 183.83         | 103.50         | 143.67 | 1028.66        | 985.83         | 1007.25 | 1703.50        | 956.00         | 1329.75 | 228.65         | 120.07         | 174.36 | 1932.15        | 1076.07        | 1504.11 |
|                | D <sub>2</sub> | 1143.50        | 1559.83        | 1351.67 | 60.50          | 107.00         | 83.75  | 1204.00        | 1666.83        | 1435.42 | 2388.33        | 1439.17        | 1913.75 | 137.00         | 159.95         | 148.48 | 2525.33        | 1599.12        | 2062.23 |
|                | D <sub>3</sub> | 1151.67        | 1575.33        | 1363.50 | 75.50          | 100.67         | 88.08  | 1227.17        | 1676.00        | 1451.58 | 1288.83        | 1456.17        | 1372.50 | 110.47         | 199.15         | 154.81 | 1399.30        | 1655.32        | 1527.31 |
|                | Mean           | 1046.67        | 1339.17        | 1192.92 | 106.61         | 103.72         | 105.17 | 1153.28        | 1442.89        | 1298.08 | 1793.56        | 1283.78        | 1538.67 | 158.71         | 159.72         | 159.21 | 1952.26        | 1443.50        | 1697.88 |
| H <sub>2</sub> | D <sub>1</sub> | 504.33         | 490.83         | 497.58  | 19.65          | 72.50          | 46.08  | 523.98         | 563.33         | 543.66  | 841.17         | 725.50         | 783.33  | 211.13         | 103.22         | 157.18 | 1052.30        | 828.72         | 940.51  |
|                | D <sub>2</sub> | 670.33         | 1069.67        | 870.00  | 51.48          | 12.00          | 31.74  | 721.82         | 1081.67        | 901.74  | 456.67         | 924.83         | 690.75  | 103.18         | 121.40         | 112.29 | 559.85         | 1046.23        | 803.04  |
|                | D <sub>3</sub> | 713.17         | 978.50         | 845.83  | 63.50          | 17.65          | 40.58  | 776.67         | 996.15         | 886.41  | 716.67         | 637.33         | 677.00  | 75.92          | 189.18         | 132.55 | 792.58         | 826.51         | 809.55  |
|                | Mean           | 629.28         | 846.33         | 737.81  | 44.88          | 34.05          | 39.46  | 674.16         | 880.38         | 777.27  | 671.50         | 762.56         | 717.03  | 130.08         | 137.93         | 134.01 | 801.58         | 900.49         | 851.03  |
| H <sub>3</sub> | D <sub>1</sub> | 474.17         | 316.17         | 395.17  | 23.50          | 12.50          | 18.00  | 497.67         | 328.67         | 413.17  | 444.67         | 402.67         | 423.67  | 31.42          | 25.23          | 28.33  | 176.08         | 427.90         | 451.99  |
|                | D <sub>2</sub> | 310.33         | 240.83         | 275.58  | 39.60          | 93.00          | 66.30  | 349.93         | 333.83         | 341.88  | 229.83         | 347.23         | 288.53  | 66.40          | 101.25         | 83.83  | 296.23         | 448.48         | 372.36  |
|                | D <sub>3</sub> | 396.33         | 227.00         | 311.67  | 57.50          | 44.57          | 51.03  | 453.83         | 271.57         | 362.70  | 359.00         | 401.00         | 380.00  | 73.83          | 62.35          | 68.09  | 432.83         | 463.35         | 448.09  |
|                | Mean           | 393.61         | 261.33         | 327.47  | 40.20          | 50.02          | 45.11  | 433.81         | 311.36         | 372.58  | 344.50         | 383.63         | 364.07  | 57.22          | 62.94          | 60.08  | 401.72         | 446.58         | 424.15  |
| Mean of V      | D <sub>1</sub> | 607.78         | 563.11         | 585.44  | 75.66          | 62.83          | 69.25  | 683.44         | 625.94         | 654.69  | 996.44         | 694.72         | 845.58  | 157.07         | 82.84          | 119.95 | 1153.51        | 777.56         | 965.54  |
|                | D <sub>2</sub> | 708.06         | 956.78         | 832.42  | 50.53          | 70.67          | 60.60  | 758.58         | 1027.44        | 893.01  | 1024.94        | 903.74         | 964.34  | 102.19         | 127.53         | 114.86 | 1127.14        | 1031.28        | 1079.21 |
|                | D <sub>3</sub> | 753.72         | 926.94         | 840.33  | 65.50          | 54.29          | 59.90  | 819.22         | 981.24         | 900.23  | 788.17         | 831.50         | 809.83  | 86.74          | 150.23         | 118.48 | 874.91         | 981.73         | 928.32  |
|                | Mean           | 689.85         | 815.61         | 752.73  | 63.90          | 62.60          | 63.25  | 753.75         | 878.21         | 815.98  | 936.52         | 809.99         | 873.25  | 115.33         | 120.20         | 117.77 | 1051.85        | 930.19         | 991.02  |

|                   |        |       |        |        |       |        |
|-------------------|--------|-------|--------|--------|-------|--------|
| Weed control (H)  | 134.9  | 24.49 | 139.81 | 221.77 | 24.96 | 225.86 |
| Plant density (D) | 104.27 | n.s   | 99.02  | n.s    | n.s   | n.s    |
| Varieties (V)     | n.s    | n.s   | 171.51 | n.s    | n.s   | n.s.   |
| HxD               | 180.61 | n.s   | n.s    | 338.68 | n.s   | 349.67 |
| HxV               | 230.78 | n.s   | 234.64 | n.s    | n.s   | n.s    |
| DxV               | n.s    | n.s   | n.s    | n.s    | n.s   | n.s    |
| HxDxV             | n.s    | 85.47 | n.s    | n.s    | 98.64 | n.s    |

plant density was of lower effect on weed control than chemical or mechanical practices.

Soybean varieties, as the third main factors did not show significant effect on weeds. This result is in full harmony with that of **Hassanein et al (2000) and Pandya et al (2005)**.

$H_3D_2$  interaction resulted in the lowest weights of BFW (275.58) and (288.53) in the first and second sample respectively, and total weed (372.36  $g/m^2$ ) in the older sample. Also,  $H_3V_2$  decreased weed weight to 261.33 for BFW and 311.36  $g/m^2$  for total weeds in the first sample.  $H_3V_1$  interaction gave total weed weight similar to that of  $H_3V_2$ , indicating similar varieties response to this plant density from the point of allowing weed growth. The trio-interaction (HDV) had a significant effect on NFW in both samples. The lowest weights were recorded as the effective influence of  $H_2D_2V_2$  interaction (12.0) in the first sample and  $H_3D_1V_2$  (25.23  $g/m^2$ ) compared with the greatest weights of  $H_1D_1V_1$  (183.83) and (228.65  $g/m^2$ ) in the first and second sample, respectively.

## 2. Soybean chemical constituent:

Due to weed control treatments, all chemical constituents studied in the two vegetative growth samples exerted significant differences except total carotenoids and anthocyanin in the second sample (Table 2). Both chemical ( $H_2$ ) and manual hoeing ( $H_3$ ) treatments surpassed the unweeded one ( $H_1$ ). These results showed that the presence of weeds in soybean field had deleterious effect on its vegetative growth which may be reflected in partial physiological inhibition of the crop activity owing to heavy competition of weeds. The mean estimates were in favour to  $H_3$  for total sugars (39.66 mg/g DW) and total phenols (4.96 mg/g DW) in the first and second sample, respectively. However, the other estimates were in favour to  $H_2$  in the two samples, but the differences between the effect of  $H_2$  and  $H_3$  did not reach the significance level for phenols, carotenoids and anthocyanin. Connecting with the above mentioned weed control treatments (Table 1), it seems that clear reduction in weeds associated with manual hoeing, which were mostly lower than those of Butralin, caused slackening in chemical constituents synthesized by soybean plant. While with Butralin, synthesis of these constituents was enhanced as defence against the remained low weeds. However, under  $H_1$  treatment which obviously concomitant with a lot of weeds, soybean plant failed to compete and consequently produced the lowest estimates.

Hill spacing had considerable effect on chemical constituents under the study in both vegetative samples, except total chlorophyll in the first one and total amino acids in both samples (Table 2). Closed spacing ( $D_1$ ) was superior for amino acids (13.46 mg/g DW) and chlorophyll (1.76 g/g FW) of the second sample as well as carotenoids (152.35 and 145.65 mg/g FW) and anthocyanin (22.6 mg/g) in the young and older sample, respectively. The intermediate plant density ( $D_2$ ) produced the highest estimates of indols (2.95 mg/g DW, in the first sample, which was insignificantly different from that of  $D_1$  (2.87 mg/g) and 3.88 mg/g in the second sample.  $D_2$  also showed high estimates for total sugars (38.73 and 58.52), phenols (7.65 and 5.05), carotenoids (142.85 and 134.38) and anthocyanin (21.31 and 23.08) in the first and second sample, respectively. However, the widest plant spacing ( $D_3$ ) gave similar, but lower estimates for these characteristics. These results

revealed the suitability of D<sub>1</sub> and /or D<sub>2</sub> for growing soybean, which keep an appropriate space for plant growth allowing it to obtain its requirements from its ambient atmosphere such as light, water and nutrients. Respecting to **Wells (1991)** stated that plant spacing greatly influenced leaf area, light interception and canopy which in turn affect the photosynthesis in soybean plants.

The two soybean varieties exhibited few significant differences in their chemical constituents, especially in the young age. Where Giza 21 (V<sub>2</sub>) gave the highest estimates of sugars (38.73 mg/g) and phenols (7.65 mg/g) in the early sample as well as for carotenoids (143.7 mg/g) in the late one. Whereas, Giza111 (V<sub>1</sub>) surpassed V<sub>2</sub> in anthocyanin (22.60 mg/g) in the first sample (Table 2).

Dual interaction (HxD) had conspicuous effect on all chemical constituents estimated in both samples, except total chlorophyll in the first one (Table 3). H<sub>1</sub>D<sub>3</sub> interaction for phenol (8.69 and 5.47 mg/g) in the first and second sample, respectively, and H<sub>2</sub>D<sub>1</sub> for carotenoids (160.42 mg/g) in the first sample were superior. H<sub>2</sub>D<sub>2</sub> interaction had the highest values for amino acids (11.44 mg/g) in the young age, and indols (3.32 and 4.23 mg/g) in the two samples. The more obvious interaction was H<sub>2</sub>D<sub>3</sub> where it positively several estimates, i.e., chlorophyll (1.72 and 1.84 g/g) and anthocyanin (24.21 and 25.93 mg/g) in the first and second samples, respectively, as well as sugars (64.63) and free amino acids (15.07 mg/g) in the second sample. This may be due to the wider space (D<sub>3</sub>) together with Butralin (H<sub>2</sub>) which gave each plant a full opportunity to obtain all of its environmental requirements and reflected in vigorous growth and consequently enhanced the photosynthesis and photosynthates accumulation in soybean plants. H<sub>3</sub>D<sub>1</sub> interaction for carotenoids (155.83 in the second sample) and H<sub>3</sub>D<sub>2</sub> for sugars (41.76 mg/g in the first sample) gave the greatest values, with insignificant differences from that of H<sub>2</sub>D<sub>3</sub> (41.39).

HxV interaction followed the same trend showed by the above mentioned one, where it significantly affected all estimates in the two samples except total chlorophyll in the first sample (Table 3). The highest estimates of phenols (8.40 in the first and 5.27 mg/g in the second sample) due to H<sub>1</sub>V<sub>1</sub> interaction effect, indols (3.86 mg/g in the second sample) due to H<sub>1</sub>V<sub>2</sub> effect, and total chlorophyll (1.81 g/g in the second sample) due to H<sub>2</sub>V<sub>2</sub> were recorded. The more important interaction was H<sub>3</sub>V<sub>2</sub> where it produced the highest estimates for sugar (41.19 and 58.54) free amino acids (9.13 and 13.29) carotenoids (151.62 and 146.72) and anthocyanin (22.22 and 23.91) in the first and second sample, respectively, in addition to indols (2.96) in the first sample. These results confirmed the early recorded for H<sub>3</sub>V<sub>2</sub> interaction concerning its suppression effect weed weights to the lowest level, acquiring soybean plants some physiological advantages, and may be taken as indicator for improved productivity of Giza 21 variety (V<sub>2</sub>) treated manual hoeing (H<sub>3</sub>).

DxV interaction showed marked effect on all traits, except chlorophyll and anthocyanin in both samples as well as indols and free amino acids in the second one (Table 3). The greatest estimate of carotenoids (153.58 in the first sample) due to D<sub>1</sub>V<sub>1</sub> effect, as well as free amino acids (9.57) and indols (3.04) due to D<sub>1</sub>V<sub>2</sub> in the first sample and carotenoids (146.89 mg/g) in the second one were detected. D<sub>2</sub>V<sub>1</sub> interaction seemed to be effectiveness for phenols in young age as well as sugars and phenols (5.16 mg/g) in the older

Table 2. Chemical constituents of soybean as affected by the main experimental factors, combined data overall the two seasons.

| Treat.         | Sample (1)                       |                                |                          |                         |                          |                              |                              | Sample (2)                |                                |                          |                         |                          |                              |                              |
|----------------|----------------------------------|--------------------------------|--------------------------|-------------------------|--------------------------|------------------------------|------------------------------|---------------------------|--------------------------------|--------------------------|-------------------------|--------------------------|------------------------------|------------------------------|
|                | Total sugar<br>(mg/g D.W)        | T. F. amino acid<br>(mg/g D.W) | T. Indolis<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) | Total sugar<br>(mg/g D.W) | T. F. amino acid<br>(mg/g D.W) | T. Indolis<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) |
|                | <b>Mean of weed control (H)</b>  |                                |                          |                         |                          |                              |                              |                           |                                |                          |                         |                          |                              |                              |
| H <sub>1</sub> | 37.44                            | 7.36                           | 2.67                     | 8.11                    | 1.45                     | 135.99                       | 21.07                        | 52.68                     | 12.20                          | 3.73                     | 5.18                    | 1.58                     | 134.79                       | 22.99                        |
| H <sub>2</sub> | 38.70                            | 10.46                          | 3.11                     | 6.81                    | 1.62                     | 154.28                       | 22.55                        | 60.71                     | 14.35                          | 4.04                     | 4.40                    | 1.73                     | 138.57                       | 24.11                        |
| H <sub>3</sub> | 39.66                            | 8.61                           | 2.85                     | 6.94                    | 1.50                     | 145.24                       | 22.02                        | 56.73                     | 13.23                          | 3.52                     | 4.96                    | 1.51                     | 142.42                       | 23.58                        |
| LSD 5%         | 0.38                             | 0.24                           | 0.15                     | 0.31                    | 0.13                     | 15.22                        | 0.99                         | 1.0                       | 0.13                           | 0.17                     | 0.14                    | 0.10                     | n.s                          | n.s                          |
|                | <b>Mean of plant density (D)</b> |                                |                          |                         |                          |                              |                              |                           |                                |                          |                         |                          |                              |                              |
| D <sub>1</sub> | 38.17                            | 8.82                           | 2.87                     | 6.80                    | 1.59                     | 152.35                       | 22.60                        | 54.06                     | 13.46                          | 3.73                     | 4.60                    | 1.76                     | 145.64                       | 24.26                        |
| D <sub>2</sub> | 38.73                            | 8.96                           | 2.95                     | 7.65                    | 1.49                     | 142.85                       | 21.31                        | 58.52                     | 13.18                          | 3.88                     | 5.05                    | 1.54                     | 134.38                       | 23.08                        |
| D <sub>3</sub> | 38.89                            | 8.65                           | 2.81                     | 7.41                    | 1.50                     | 140.31                       | 21.73                        | 57.53                     | 13.14                          | 3.69                     | 4.88                    | 1.52                     | 135.75                       | 23.34                        |
| LSD 5%         | 0.50                             | n.s                            | 0.12                     | 0.39                    | n.s                      | 8.10                         | 0.79                         | 2.00                      | n.s                            | 0.13                     | 0.20                    | 0.13                     | 4.86                         | 0.84                         |
|                | <b>Mean of varieties(V)</b>      |                                |                          |                         |                          |                              |                              |                           |                                |                          |                         |                          |                              |                              |
| V1             | 38.17                            | 8.82                           | 2.87                     | 6.80                    | 1.54                     | 152.35                       | 22.60                        | 55.81                     | 13.07                          | 3.73                     | 4.80                    | 1.62                     | 133.48                       | 23.61                        |
| V2             | 38.73                            | 8.96                           | 2.95                     | 7.65                    | 1.50                     | 142.85                       | 21.31                        | 57.60                     | 13.45                          | 3.80                     | 4.89                    | 1.60                     | 143.70                       | 23.51                        |
| LSD 5%         | 0.49                             | n.s                            | n.s                      | 0.44                    | n.s                      | n.s                          | 1.01                         | n.s                       | n.s                            | n.s                      | n.s                     | n.s                      | 8.08                         | n.s                          |



Table 3. Some chemical constituents of soybean as affected by dual interaction between tested factors, overall the two seasons.

| Treat.                        | Sample(1)   |                                |                         |                         |                          |                              |                              | Sample(2)                 |                                |                         |                         |                          |                              |                              |
|-------------------------------|---|--------------------------------|-------------------------|-------------------------|--------------------------|------------------------------|------------------------------|---------------------------|--------------------------------|-------------------------|-------------------------|--------------------------|------------------------------|------------------------------|
|                               | Total sugar<br>(mg/g D.W)                               | T. F. amino acid<br>(mg/g D.W) | T. Indols<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) | Total sugar<br>(mg/g D.W) | T. F. amino acid<br>(mg/g D.W) | T. Indols<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) |
|                               | <b>Mean of weed control and plant density (H&amp;D)</b> |                                |                         |                         |                          |                              |                              |                           |                                |                         |                         |                          |                              |                              |
| H <sub>1</sub> D <sub>1</sub> | 38.22   | 7.97                           | 2.83                    | 7.91                    | 1.60                     | 147.01                       | 21.93                        | 51.48                     | 12.99                          | 3.92                    | 5.15                    | 1.68                     | 139.50                       | 24.35                        |
| H <sub>1</sub> D <sub>2</sub> | 37.58   | 6.95                           | 2.60                    | 7.74                    | 1.33                     | 135.53                       | 21.18                        | 55.79                     | 11.93                          | 3.66                    | 4.91                    | 1.55                     | 127.87                       | 23.11                        |
| H <sub>1</sub> D <sub>3</sub> | 36.51   | 7.16                           | 2.57                    | 8.69                    | 1.43                     | 125.43                       | 20.10                        | 50.76                     | 11.68                          | 3.63                    | 5.47                    | 1.51                     | 137.00                       | 21.51                        |
| H <sub>2</sub> D <sub>1</sub> | 37.85   | 9.29                           | 3.03                    | 6.34                    | 1.57                     | 160.42                       | 22.41                        | 57.04                     | 13.48                          | 3.99                    | 4.19                    | 1.81                     | 141.58                       | 23.61                        |
| H <sub>2</sub> D <sub>2</sub> | 36.85   | 11.44                          | 3.32                    | 7.82                    | 1.57                     | 148.75                       | 21.03                        | 60.46                     | 14.51                          | 4.23                    | 4.93                    | 1.54                     | 134.37                       | 22.79                        |
| H <sub>2</sub> D <sub>3</sub> | 41.39   | 10.67                          | 2.99                    | 6.26                    | 1.72                     | 153.67                       | 24.21                        | 64.63                     | 15.07                          | 3.90                    | 4.07                    | 1.84                     | 139.75                       | 25.93                        |
| H <sub>3</sub> D <sub>1</sub> | 38.45   | 9.21                           | 2.75                    | 6.14                    | 1.59                     | 149.62                       | 23.46                        | 53.67                     | 13.92                          | 3.29                    | 4.47                    | 1.79                     | 155.83                       | 24.82                        |
| H <sub>3</sub> D <sub>2</sub> | 41.76   | 8.50                           | 2.94                    | 7.38                    | 1.56                     | 144.27                       | 21.72                        | 59.31                     | 13.11                          | 3.74                    | 5.31                    | 1.54                     | 140.92                       | 23.34                        |
| H <sub>3</sub> D <sub>3</sub> | 38.78   | 8.12                           | 2.87                    | 7.29                    | 1.35                     | 141.83                       | 20.89                        | 57.22                     | 12.67                          | 3.53                    | 5.09                    | 1.21                     | 130.50                       | 22.59                        |
| LSD 5%                        | 0.86  | 1.43                           | 0.21                    | 0.68                    | n.s                      | 14.04                        | 1.37                         | 3.46                      | 1.36                           | 0.22                    | 0.35                    | 0.22                     | 8.41                         | 1.46                         |
|                               | <b>Mean of weed control and varieties (H&amp;V)</b>     |                                |                         |                         |                          |                              |                              |                           |                                |                         |                         |                          |                              |                              |
| H <sub>1</sub> V <sub>1</sub> | 36.74   | 7.35                           | 2.57                    | 8.40                    | 1.45                     | 134.59                       | 21.27                        | 52.59                     | 12.09                          | 3.60                    | 5.27                    | 1.70                     | 132.41                       | 23.10                        |
| H <sub>1</sub> V <sub>2</sub> | 38.13   | 7.37                           | 2.76                    | 7.82                    | 1.45                     | 137.39                       | 20.87                        | 52.76                     | 12.30                          | 3.86                    | 5.08                    | 1.46                     | 137.17                       | 22.88                        |
| H <sub>2</sub> V <sub>1</sub> | 28.76   | 7.44                           | 2.26                    | 4.98                    | 1.60                     | 112.92                       | 17.12                        | 44.94                     | 10.43                          | 3.00                    | 3.30                    | 1.65                     | 97.43                        | 18.36                        |
| H <sub>2</sub> V <sub>2</sub> | 29.29   | 8.26                           | 2.40                    | 5.23                    | 1.64                     | 118.50                       | 16.71                        | 46.12                     | 11.10                          | 3.05                    | 3.30                    | 1.81                     | 110.42                       | 17.80                        |
| H <sub>3</sub> V <sub>1</sub> | 38.14   | 8.09                           | 2.75                    | 7.04                    | 1.58                     | 138.86                       | 21.83                        | 54.92                     | 13.20                          | 3.58                    | 4.73                    | 1.51                     | 138.11                       | 23.26                        |
| H <sub>3</sub> V <sub>2</sub> | 41.19   | 9.13                           | 2.96                    | 6.83                    | 1.42                     | 151.62                       | 22.22                        | 58.54                     | 13.26                          | 3.46                    | 5.19                    | 1.51                     | 146.72                       | 23.91                        |
| LSD 5%                        | 0.85  | 1.33                           | 0.27                    | 0.77                    | n.s                      | 16.48                        | 1.74                         | 4.67                      | 1.16                           | 0.36                    | 0.55                    | 0.20                     | 13.99                        | 1.70                         |
|                               | <b>Mean of plant density and varieties (D&amp;V)</b>    |                                |                         |                         |                          |                              |                              |                           |                                |                         |                         |                          |                              |                              |
| D <sub>1</sub> V <sub>1</sub> | 37.02   | 8.08                           | 2.70                    | 6.78                    | 1.61                     | 153.58                       | 22.81                        | 51.80                     | 13.07                          | 3.68                    | 4.42                    | 1.80                     | 144.39                       | 24.38                        |
| D <sub>1</sub> V <sub>2</sub> | 39.33   | 9.57                           | 3.04                    | 6.81                    | 1.56                     | 151.11                       | 22.39                        | 56.32                     | 13.86                          | 3.79                    | 4.79                    | 1.72                     | 146.89                       | 24.14                        |
| D <sub>2</sub> V <sub>1</sub> | 39.11   | 9.41                           | 2.96                    | 7.85                    | 1.49                     | 136.97                       | 21.49                        | 59.48                     | 13.54                          | 3.87                    | 5.16                    | 1.49                     | 123.93                       | 23.13                        |
| D <sub>2</sub> V <sub>2</sub> | 38.36   | 8.51                           | 2.94                    | 7.44                    | 1.49                     | 148.73                       | 21.12                        | 57.56                     | 12.82                          | 3.89                    | 4.93                    | 1.59                     | 144.83                       | 23.03                        |
| D <sub>3</sub> V <sub>1</sub> | 37.11   | 7.87                           | 2.68                    | 7.44                    | 1.53                     | 133.46                       | 21.61                        | 56.15                     | 12.58                          | 3.65                    | 4.81                    | 1.57                     | 132.11                       | 23.34                        |
| D <sub>3</sub> V <sub>2</sub> | 40.68   | 9.43                           | 2.94                    | 7.38                    | 1.47                     | 147.17                       | 21.86                        | 58.92                     | 13.69                          | 3.73                    | 4.94                    | 1.47                     | 139.39                       | 23.34                        |
| LSD 5%                        | 0.85  | 1.33                           | 0.27                    | 0.77                    | n.s                      | 16.48                        | n.s                          | 4.67                      | n.s                            | n.s                     | 0.55                    | n.s                      | 13.99                        | n.s                          |

Table 4. Effect of interactions between weed control (H), plant density (D) and varieties (V) on some chemical constituents of soybean over all two seasons.

| Treat.                                       | Sample(1)   |                                   |                         |                         |                          |                              |                              | Sample(2)                 |                                   |                         |                         |                          |                              |                              |
|--|---|-----------------------------------|-------------------------|-------------------------|--------------------------|------------------------------|------------------------------|---------------------------|-----------------------------------|-------------------------|-------------------------|--------------------------|------------------------------|------------------------------|
|  | Total sugar<br>(mg/g D.W)   | T. F. amino<br>acid<br>(mg/g D.W) | T. Indols<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) | Total sugar<br>(mg/g D.W) | T. F. amino<br>acid<br>(mg/g D.W) | T. Indols<br>(µg/g D.W) | T. phenol<br>(mg/g D.W) | Total chlo<br>(µg/g F.W) | T. carotenoids<br>(µg/g F.W) | Anthocyanin<br>(mg/100g D.W) |
|  | Mean of weed control, plant density and varieties interactions(H&D&V) |                                   |                         |                         |                          |                              |                              |                           |                                   |                         |                         |                          |                              |                              |
| H <sub>1</sub> D <sub>1</sub> V <sub>1</sub> | 35.97   | 7.52                              | 2.51                    | 8.31                    | 1.57                     | 138.18                       | 21.45                        | 47.88                     | 13.02                             | 3.82                    | 4.58                    | 1.75                     | 135.00                       | 24.43                        |
| H <sub>1</sub> D <sub>1</sub> V <sub>2</sub> | 40.47   | 8.42                              | 3.15                    | 7.51                    | 1.62                     | 155.83                       | 22.42                        | 55.07                     | 12.97                             | 4.01                    | 5.72                    | 1.61                     | 144.00                       | 24.27                        |
| H <sub>1</sub> D <sub>2</sub> V <sub>1</sub> | 37.50   | 6.55                              | 2.51                    | 8.59                    | 1.28                     | 137.73                       | 20.30                        | 54.50                     | 11.05                             | 3.40                    | 5.72                    | 1.47                     | 119.73                       | 21.90                        |
| H <sub>1</sub> D <sub>2</sub> V <sub>2</sub> | 37.67   | 7.36                              | 2.69                    | 6.88                    | 1.38                     | 133.33                       | 22.05                        | 57.08                     | 12.80                             | 3.92                    | 4.09                    | 1.63                     | 136.00                       | 24.32                        |
| H <sub>1</sub> D <sub>3</sub> V <sub>1</sub> | 36.77   | 7.98                              | 2.69                    | 8.30                    | 1.51                     | 127.87                       | 22.05                        | 55.40                     | 12.22                             | 3.59                    | 5.52                    | 1.87                     | 142.50                       | 22.97                        |
| H <sub>1</sub> D <sub>3</sub> V <sub>2</sub> | 36.25   | 6.35                              | 2.45                    | 9.07                    | 1.35                     | 123.00                       | 18.15                        | 46.12                     | 11.14                             | 3.66                    | 5.43                    | 1.15                     | 131.50                       | 20.05                        |
| H <sub>2</sub> D <sub>1</sub> V <sub>1</sub> | 36.98   | 7.52                              | 2.83                    | 6.18                    | 1.60                     | 168.50                       | 22.47                        | 55.00                     | 12.05                             | 3.85                    | 4.39                    | 1.73                     | 135.17                       | 23.55                        |
| H <sub>2</sub> D <sub>1</sub> V <sub>2</sub> | 38.72   | 11.06                             | 3.24                    | 6.50                    | 1.54                     | 152.33                       | 22.35                        | 59.08                     | 14.92                             | 4.13                    | 3.99                    | 1.89                     | 148.00                       | 23.67                        |
| H <sub>2</sub> D <sub>2</sub> V <sub>1</sub> | 38.60   | 13.45                             | 3.50                    | 7.42                    | 1.43                     | 133.33                       | 22.07                        | 63.42                     | 16.10                             | 4.26                    | 4.74                    | 1.45                     | 117.57                       | 24.02                        |
| H <sub>2</sub> D <sub>2</sub> V <sub>2</sub> | 35.10   | 9.42                              | 3.13                    | 8.22                    | 1.72                     | 164.17                       | 20.00                        | 57.50                     | 12.92                             | 4.19                    | 5.11                    | 1.64                     | 151.17                       | 21.57                        |
| H <sub>2</sub> D <sub>3</sub> V <sub>1</sub> | 39.45   | 8.79                              | 2.73                    | 6.31                    | 1.78                     | 149.83                       | 23.93                        | 61.35                     | 13.57                             | 3.90                    | 4.06                    | 1.77                     | 137.00                       | 25.88                        |
| H <sub>2</sub> D <sub>3</sub> V <sub>2</sub> | 43.33   | 12.55                             | 3.25                    | 6.22                    | 1.66                     | 157.50                       | 24.48                        | 67.90                     | 16.57                             | 3.90                    | 4.08                    | 1.91                     | 142.50                       | 25.97                        |
| H <sub>3</sub> D <sub>1</sub> V <sub>1</sub> | 38.10   | 9.20                              | 2.76                    | 5.85                    | 1.67                     | 154.07                       | 24.52                        | 52.52                     | 14.15                             | 3.36                    | 4.30                    | 1.92                     | 163.00                       | 25.15                        |
| H <sub>3</sub> D <sub>1</sub> V <sub>2</sub> | 38.80   | 9.22                              | 2.74                    | 6.43                    | 1.52                     | 145.17                       | 22.40                        | 54.82                     | 13.69                             | 3.23                    | 4.64                    | 1.66                     | 148.67                       | 24.48                        |
| H <sub>3</sub> D <sub>2</sub> V <sub>1</sub> | 41.22   | 8.24                              | 2.87                    | 7.54                    | 1.76                     | 139.83                       | 22.12                        | 60.53                     | 13.48                             | 3.94                    | 5.02                    | 1.56                     | 134.50                       | 23.47                        |
| H <sub>3</sub> D <sub>2</sub> V <sub>2</sub> | 42.30   | 8.76                              | 3.01                    | 7.22                    | 1.36                     | 148.70                       | 21.32                        | 58.08                     | 12.73                             | 3.55                    | 5.60                    | 1.52                     | 147.33                       | 23.22                        |
| H <sub>3</sub> D <sub>3</sub> V <sub>1</sub> | 35.10   | 6.84                              | 2.62                    | 7.72                    | 1.31                     | 122.67                       | 18.85                        | 51.70                     | 11.97                             | 3.45                    | 4.86                    | 1.06                     | 116.83                       | 21.17                        |
| H <sub>3</sub> D <sub>3</sub> V <sub>2</sub> | 42.47   | 9.41                              | 3.12                    | 6.85                    | 1.39                     | 161.00                       | 22.93                        | 62.73                     | 13.37                             | 3.61                    | 5.32                    | 1.36                     | 144.17                       | 24.02                        |
| LSD 5%                                       | 1.47  | 2.30                              | 0.47                    | 1.33                    | n.s                      | 28.55                        | 3.02                         | 8.10                      | 2.01                              | 0.62                    | 0.96                    | 0.35                     | 24.23                        | 2.95                         |

age. While  $D_3V_2$  interaction showed greatest effect on total sugars (40.68 mg/g) in young age.

The triointeraction ( $H \times D \times V$ ) exerted significant effect on all estimated traits of the two vegetative sample, except total chlorophyll in the first one (Table 4). The greatest total phenols (9.07) of the first sample and (5.72) of the second one were obtained by  $H_1D_3V_2$  and  $H_1D_2V_1$  interactions, respectively. The highest total carotenoids estimated in the first sample (168.50 mg/g) and in the second one (163.00 mg/g) were recorded for  $H_2D_1V_1$  and  $H_3D_1V_1$  interaction, respectively.  $H_3D_1V_1$  interaction had positive marked effect on anthocyanin (24.52 mg/g) in the first sample, and total chlorophyll (1.92 g/g) in the second one. In addition to the latter interaction, the other two important triointeraction were  $H_2D_2V_1$  and  $H_2D_3V_2$ . Due to the former, greatest total amino acids (13.45) in the first sample and indols (3.50 and 4.26 mg/g) in the two samples were recorded. Highest estimates of total sugars (43.33 and 67.90 mg/g) in the two samples, as well as free amino acids (16.57) and anthocyanin (25.97) were obtained by  $H_2D_3V_2$  interaction. These results supported the above mentioned one of dual interaction (Table 3) and revealed the importance of these three triointeractions, allowing the plant to form greatest biomass with active synthesis of oil, protein and carbohydrates, which if combined with quit proper translocation to sink, high productivity become expected.

#### **b. Soybean yield and its components:**

The data in Table (5) show sufficient distinct difference, due to weed control treatments, for all studied traits except protein percentages. Both Butralin ( $H_2$ ) and manual hoeing ( $H_3$ ) surpassed the unweeded treatment ( $H_1$ ) for all traits, indicating again the necessity of weed control in soybean field.  $H_2$  was only superior i.e., plant height, whereas manual hoeing ( $H_3$ ) had pronounced advantage for the productive traits. This may be ascribed to greater effect of  $H_3$  in weed elimination ratios as shown in Table (1) (62.3-76.3%) than that of Butralin (62.5%) and consequently, soybean plants exposed to more weed competition under  $H_2$  pushed it to elongated. Superiority of mechanical weeding over chemical one was previously reported by several authors (Ball *et al*, 2000, Galal, 2003; Manjusha *et al*, 2004; Umale *et al*, 2005 and Idaquganti *et al*, 2005). However, insignificant differences between both on seed yield (Hassanein *et al*, 2000) and on seed index (Silva, 2008).

Due to hill spacing, significant differences were detected for six out of ten studied traits (Table 5). Narrow hill spacing ( $D_1$ ) produced perspective advantages for plant height (64.94cm) number of branches (2.87 br.) number of pods (65.95 pod), pods weight (100.09 g), plant seed weight (42.22 g) and seed yield/fed (1.08 t). The intermediate plant density ( $D_2$ ) gave number of pods and seed yield/fed. insignificantly different from those of  $D_1$ . However, the wider hill spacing produced the lowest values for all traits except oil percentage. These advantage effect of  $D_1$  over  $D_2$  may be due to its weed elimination was the highest (Table 1), and indicated that seed yield/fed depended mainly on number of plants in both experimental plant density in favour to  $D_1$ . These results are in harmony with those of Parvez *et al* (1989) Pires *et al* (2001) and Andrade *et al* (2002). However, Veeramani *et al* (2001) found insignificant differences due to plant density effect on seed yield.

Table 5. Yield and quality traits of soybean as affected by the main experimental factors

| Treat.                           | Pl. H.<br>(cm) | Brs/pl      | Pods/pl     | Pods<br>wt./pl<br>(g) | Seed<br>wt./pl<br>(g) | S.I<br>(g)  | S.Y/f<br>(ton) | Carbo.<br>% | Prot.<br>% | Oil<br>%   |
|----------------------------------|----------------|-------------|-------------|-----------------------|-----------------------|-------------|----------------|-------------|------------|------------|
| <b>Mean of weed control (H)</b>  |                |             |             |                       |                       |             |                |             |            |            |
| H <sub>1</sub>                   | 54.11          | 2.18        | 22.09       | 30.17                 | 11.16                 | 10.32       | 0.53           | 21.59       | 44.02      | 19.86      |
| H <sub>2</sub>                   | 69.90          | 2.84        | 79.41       | 110.11                | 41.07                 | 12.76       | 1.00           | 21.45       | 42.77      | 19.08      |
| H <sub>3</sub>                   | 62.75          | 3.16        | 88.17       | 132.25                | 53.99                 | 12.11       | 1.49           | 22.03       | 42.27      | 19.44      |
| <b>LSD 5%</b>                    | <b>1.18</b>    | <b>0.13</b> | <b>2.93</b> | <b>4.54</b>           | <b>2.13</b>           | <b>0.73</b> | <b>0.13</b>    | <b>0.44</b> | <b>n.s</b> | <b>n.s</b> |
| <b>Mean of plant density (D)</b> |                |             |             |                       |                       |             |                |             |            |            |
| D <sub>1</sub>                   | 64.94          | 2.87        | 65.95       | 100.09                | 42.22                 | 12.13       | 1.08           | 21.59       | 44.32      | 18.85      |
| D <sub>2</sub>                   | 60.36          | 2.78        | 65.76       | 91.41                 | 33.59                 | 11.61       | 1.06           | 21.81       | 42.48      | 18.93      |
| D <sub>3</sub>                   | 61.46          | 2.52        | 57.97       | 81.02                 | 30.41                 | 11.45       | 0.89           | 21.68       | 42.26      | 20.61      |
| <b>LSD 5%</b>                    | <b>1.17</b>    | <b>0.01</b> | <b>3.89</b> | <b>5.10</b>           | <b>3.60</b>           | <b>n.s</b>  | <b>0.13</b>    | <b>n.s</b>  | <b>n.s</b> | <b>n.s</b> |
| <b>Mean of varieties(V)</b>      |                |             |             |                       |                       |             |                |             |            |            |
| V <sub>1</sub>                   | 63.40          | 2.62        | 60.95       | 82.68                 | 29.63                 | 10.92       | 0.94           | 21.70       | 43.71      | 19.54      |
| V <sub>2</sub>                   | 61.11          | 2.82        | 65.50       | 99.00                 | 41.18                 | 12.54       | 1.08           | 21.69       | 42.33      | 19.38      |
| <b>LSD 5%</b>                    | <b>0.48</b>    | <b>0.07</b> | <b>0.98</b> | <b>3.03</b>           | <b>1.47</b>           | <b>0.38</b> | <b>0.07</b>    | <b>n.s</b>  | <b>n.s</b> | <b>n.s</b> |

The two tested varieties showed marked differences for all studied traits except carbohydrate, protein and oil percentages (Table 5). Giza 21 (V<sub>2</sub>) surpassed Giza111 (V<sub>1</sub>) in all traits except plant height. Superiority of V<sub>2</sub> may be attributed to its genetic background which enabled it to form great biomass combined with effective partitioning for synthates to productive organs.

Dual interaction H<sub>2</sub>D<sub>3</sub> (71.04) and H<sub>2</sub>D<sub>2</sub> (70.31 cm) had the tallest plants Table (6). H<sub>3</sub>D<sub>1</sub> interaction produced the heaviest weights of pods (161.42) plant seeds (72.97) seed index (13.20) and consequently seed yield/fed (1.84 t). Also, H<sub>3</sub>D<sub>2</sub> interaction was superior for number of pods (101.59). These results revealed that pods and seeds weights were more important than pods number for higher plant and area yields, under the same weed control treatment, and the highest plant density (D<sub>1</sub>) encouraged seed set, whereas, the intermediate density (D<sub>2</sub>) enhanced biomass formation. In this concern, Galal (2003) obtained the highest seed yield (1.15 t) from interaction of manual hoeing and 5cm plant spacing. H<sub>3</sub>D<sub>3</sub> interaction gave the highest percentage of carbohydrates (22.37%) which may be attributed to its highest total sugars estimated in the early growth stage as well as oil percentage with 21.33% (Table 3).

HxV interaction significantly affected all traits (Table 6). Tallest plants (70.28 cm) and heaviest seed index (13.13 g) produced by H<sub>2</sub>V<sub>2</sub> interaction, as well as greatest number of branches (3.22 Br.) and highest ratio of carbohydrates (22.37%) produced by H<sub>3</sub>V<sub>1</sub> interaction were detected. H<sub>3</sub>V<sub>2</sub> interaction manifested some advantages, where it produced the highest values of pods number (89.84 pod), pods weight (143.27 g) and plant seed weight (63.31 g) in addition to improved seed yield/fed (1.52 t). Superiority of H<sub>3</sub>V<sub>2</sub> interaction for these traits may be due to its advantages of most chemical constituents during growth stage (Table 3). The increase in yield and its components as well as the chemical composition of the seeds may be attributed to the increased photosynthetic rate which consequently increased the photosynthesis and the accumulation of photosynthesis and their translocation to the newly developed seeds.

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**Table 6. Yield and quality traits of soybean as affected by dual interaction between tested factors, combined overall the two seasons.**

| Treat.  | Pl. H.<br>(cm) | Brs/pl | Pods/pl | Pods<br>wt./pl<br>(g) | Seed<br>wt./pl<br>(g) | S.I<br>(g) | S.Y/f<br>(ton) | Carbo.<br>% | Prot.<br>% | Oil<br>% |
|---|----------------|--------|---------|-----------------------|-----------------------|------------|----------------|-------------|------------|----------|
| <b>Mean of weed control and plant density (H&amp;D)</b> |                |        |         |                       |                       |            |                |             |            |          |
| H <sub>1</sub> D <sub>1</sub>                           | 59.00          | 1.92   | 18.52   | 28.53                 | 11.15                 | 9.64       | 0.34           | 21.44       | 44.21      | 19.13    |
| H <sub>1</sub> D <sub>2</sub>                           | 51.80          | 2.33   | 27.80   | 35.25                 | 12.94                 | 10.29      | 0.73           | 21.83       | 45.62      | 19.92    |
| H <sub>1</sub> D <sub>3</sub>                           | 51.53          | 2.28   | 19.95   | 26.72                 | 9.39                  | 11.03      | 0.52           | 21.51       | 42.23      | 20.54    |
| H <sub>2</sub> D <sub>1</sub>                           | 68.36          | 2.90   | 81.28   | 110.33                | 42.53                 | 13.55      | 1.06           | 21.10       | 46.38      | 18.92    |
| H <sub>2</sub> D <sub>2</sub>                           | 70.31          | 2.67   | 67.88   | 92.14                 | 33.72                 | 12.33      | 0.95           | 22.10       | 39.23      | 18.38    |
| H <sub>2</sub> D <sub>3</sub>                           | 71.04          | 2.95   | 89.09   | 127.84                | 46.95                 | 12.40      | 1.00           | 21.16       | 42.71      | 19.94    |
| H <sub>3</sub> D <sub>1</sub>                           | 67.46          | 3.78   | 98.05   | 161.42                | 72.97                 | 13.20      | 1.84           | 22.23       | 42.36      | 18.50    |
| H <sub>3</sub> D <sub>2</sub>                           | 58.98          | 3.35   | 101.59  | 146.83                | 54.12                 | 12.20      | 1.50           | 21.50       | 42.58      | 18.50    |
| H <sub>3</sub> D <sub>3</sub>                           | 61.81          | 2.33   | 64.88   | 88.49                 | 34.88                 | 10.92      | 1.15           | 22.37       | 41.86      | 21.33    |
| LSD 5%  | 2.03           | 0.37   | 6.74    | 8.84                  | 6.23                  | 1.32       | 0.21           | 0.86        | 4.47       | 1.24     |
| <b>Mean of weed control and varieties (H&amp;V)</b>     |                |        |         |                       |                       |            |                |             |            |          |
| H <sub>1</sub> V <sub>1</sub>                           | 55.50          | 2.11   | 22.06   | 28.32                 | 10.52                 | 8.79       | 0.43           | 21.28       | 45.65      | 19.39    |
| H <sub>1</sub> V <sub>2</sub>                           | 52.72          | 2.24   | 22.12   | 32.02                 | 11.80                 | 11.86      | 0.64           | 21.90       | 42.38      | 20.33    |
| H <sub>2</sub> V <sub>1</sub>                           | 69.52          | 2.53   | 74.31   | 98.51                 | 33.69                 | 12.39      | 0.92           | 21.44       | 42.19      | 19.63    |
| H <sub>2</sub> V <sub>2</sub>                           | 70.28          | 3.14   | 84.52   | 121.70                | 48.44                 | 13.13      | 1.09           | 21.47       | 43.35      | 18.53    |
| H <sub>3</sub> V <sub>1</sub>                           | 65.18          | 3.22   | 86.50   | 121.22                | 44.67                 | 11.57      | 1.47           | 22.37       | 43.28      | 19.61    |
| H <sub>3</sub> V <sub>2</sub>                           | 60.32          | 3.09   | 89.84   | 143.27                | 63.31                 | 12.64      | 1.52           | 21.69       | 41.26      | 19.28    |
| LSD 5%  | 0.84           | 0.12   | 1.70    | 5.24                  | 2.55                  | 0.66       | 0.13           | 0.56        | 2.65       | 0.94     |
| <b>Mean of plant density and varieties (D&amp;V)</b>    |                |        |         |                       |                       |            |                |             |            |          |
| D <sub>1</sub> V <sub>1</sub>                           | 63.49          | 2.78   | 61.70   | 84.88                 | 30.86                 | 11.16      | 1.01           | 21.77       | 46.03      | 17.42    |
| D <sub>1</sub> V <sub>2</sub>                           | 66.39          | 2.96   | 70.19   | 115.31                | 53.57                 | 13.10      | 1.16           | 21.41       | 42.61      | 20.28    |
| D <sub>2</sub> V <sub>1</sub>                           | 62.85          | 2.67   | 66.64   | 89.81                 | 32.77                 | 10.98      | 0.86           | 20.89       | 41.44      | 19.78    |
| D <sub>2</sub> V <sub>2</sub>                           | 57.87          | 2.90   | 64.87   | 93.01                 | 34.41                 | 12.23      | 1.26           | 22.72       | 43.51      | 18.08    |
| D <sub>3</sub> V <sub>1</sub>                           | 63.86          | 2.42   | 54.52   | 73.36                 | 25.25                 | 10.61      | 0.95           | 22.43       | 43.66      | 21.43    |
| D <sub>3</sub> V <sub>2</sub>                           | 59.06          | 2.62   | 61.43   | 88.68                 | 35.57                 | 12.29      | 0.83           | 20.93       | 40.87      | 19.78    |
| LSD 5%  | 0.84           | 0.12   | 1.70    | 5.24                  | 2.55                  | n.s        | 0.13           | 0.56        | 2.65       | 0.94     |

Due to the effect of DxV interaction, all traits except seed index were markedly affected the tallest plants (66.39 cm) with greater number of branches (2.96 Br.) and pods (70.19 pod) as well as heavier weights of pods (115.31) seed of plant (53.57) and seed index (13.10 g) were produced by D<sub>1</sub>V<sub>2</sub> interaction. Whereas, the highest seed yield/fed (1.26 t) which was similar value of D<sub>1</sub>V<sub>2</sub> (1.16 t) and the highest carbohydrate ratio (22.72%) were given by D<sub>2</sub>V<sub>2</sub> interaction. These results confirmed again the superiority of Giza 21 (V<sub>2</sub>) variety under either high or intermediate plant density in favour to the former one. D<sub>3</sub>V<sub>1</sub> interaction gave the improves ratios of protein (43.66) and oil (21.43%).

Triointeraction (HxDxV) was of marked effect on all studied traits (Table7). The highest values of protein (48.10%), seed index (13.78 g) number of branches (4.0 br.) number of pods (114.55 pod) and carbohydrates (23.73%) were exhibited by H<sub>2</sub>D<sub>1</sub>V<sub>1</sub>, H<sub>2</sub>D<sub>1</sub>V<sub>2</sub>, H<sub>3</sub>D<sub>1</sub>V<sub>1</sub>, H<sub>3</sub>D<sub>2</sub>V<sub>2</sub> and H<sub>3</sub>D<sub>3</sub>V<sub>1</sub> interactions, respectively. It is worth to noting that the greatest number of branches produced by H<sub>3</sub>D<sub>1</sub>V<sub>1</sub> interaction was due to its superiority in total chlorophyll, carotenoids and anthocyanin (Table 4) which

promote the vegetative growth. Last but not least, H<sub>3</sub>D<sub>1</sub>V<sub>2</sub> interaction which was of similar values for the latter three chemical constituents in addition to its clear suppression effect for NFW (12.5&25.23 g/m<sup>2</sup> in 1<sup>st</sup>, 2<sup>nd</sup>) and partially for total weeds (Table1), resulted in great biomass combined with good partition of the syntheses of V<sub>2</sub> variety and consequently produced the highest values of pods weight (176.67 g) plant seed weight (91.72 g) and seed yield/fed (1.89 t).

**Table 7. Yield and quality traits of soybean as affected by interaction between weed control, plant density and varieties over all two seasons.**

| Treat.   | Pl. H.<br>(cm) | No.<br>Brs  | No.<br>Pods/pl | W.<br>Pods/pl<br>(g) | W.<br>seed/pl<br>(g) | S.I<br>(g)  | S.Y/f<br>(ton) | Carbo.<br>% | Prot.<br>%  | Oil<br>%    |
|--|----------------|-------------|----------------|----------------------|----------------------|-------------|----------------|-------------|-------------|-------------|
| <b>Mean of weed control, plant density and varieties interactions(H&amp;D&amp;V)</b> |                |             |                |                      |                      |             |                |             |             |             |
| H <sub>1</sub> D <sub>1</sub> V <sub>1</sub>   | 54.67          | 1.73        | 16.77          | 22.32                | 7.23                 | 7.37        | 0.28           | 20.90       | 46.82       | 17.25       |
| H <sub>1</sub> D <sub>1</sub> V <sub>2</sub>   | 63.33          | 2.10        | 20.27          | 34.75                | 15.07                | 11.92       | 0.41           | 21.98       | 41.60       | 21.00       |
| H <sub>1</sub> D <sub>2</sub> V <sub>1</sub>   | 56.62          | 2.47        | 29.85          | 37.58                | 15.88                | 9.44        | 0.40           | 21.05       | 45.88       | 20.83       |
| H <sub>1</sub> D <sub>2</sub> V <sub>2</sub>   | 46.98          | 2.20        | 25.75          | 32.92                | 9.99                 | 11.15       | 1.06           | 22.60       | 45.35       | 19.00       |
| H <sub>1</sub> D <sub>3</sub> V <sub>1</sub>   | 55.22          | 2.13        | 19.55          | 25.05                | 8.43                 | 9.56        | 0.60           | 21.90       | 44.25       | 20.08       |
| H <sub>1</sub> D <sub>3</sub> V <sub>2</sub>   | 47.85          | 2.42        | 20.35          | 28.38                | 10.35                | 12.50       | 0.44           | 21.12       | 40.20       | 21.00       |
| H <sub>2</sub> D <sub>1</sub> V <sub>1</sub>   | 63.63          | 2.60        | 68.45          | 86.17                | 31.13                | 13.32       | 0.96           | 21.02       | 48.10       | 17.25       |
| H <sub>2</sub> D <sub>1</sub> V <sub>2</sub>   | 73.08          | 3.20        | 94.10          | 134.50               | 53.93                | 13.78       | 1.17           | 21.18       | 44.67       | 20.58       |
| H <sub>2</sub> D <sub>2</sub> V <sub>1</sub>   | 70.53          | 2.43        | 81.45          | 105.02               | 37.00                | 11.97       | 0.71           | 21.65       | 37.75       | 19.25       |
| H <sub>2</sub> D <sub>2</sub> V <sub>2</sub>   | 70.08          | 2.90        | 54.30          | 79.27                | 30.43                | 12.70       | 1.19           | 22.55       | 40.70       | 17.50       |
| H <sub>2</sub> D <sub>3</sub> V <sub>1</sub>   | 74.40          | 2.57        | 73.02          | 104.35               | 32.93                | 11.90       | 1.09           | 21.65       | 40.73       | 22.38       |
| H <sub>2</sub> D <sub>3</sub> V <sub>2</sub>   | 67.68          | 3.33        | 105.17         | 151.33               | 60.97                | 12.90       | 0.92           | 20.67       | 44.68       | 17.50       |
| H <sub>3</sub> D <sub>1</sub> V <sub>1</sub>   | 72.17          | 4.00        | 99.88          | 146.17               | 54.22                | 12.80       | 1.79           | 23.40       | 43.17       | 17.75       |
| H <sub>3</sub> D <sub>1</sub> V <sub>2</sub>   | 62.75          | 3.57        | 96.22          | 176.67               | 91.72                | 13.60       | 1.89           | 21.07       | 41.55       | 19.25       |
| H <sub>3</sub> D <sub>2</sub> V <sub>1</sub>   | 61.40          | 3.10        | 88.63          | 126.83               | 45.42                | 11.55       | 1.47           | 19.98       | 40.68       | 19.25       |
| H <sub>3</sub> D <sub>2</sub> V <sub>2</sub>   | 56.55          | 3.60        | 114.55         | 166.83               | 62.82                | 12.85       | 1.52           | 23.02       | 44.48       | 17.75       |
| H <sub>3</sub> D <sub>3</sub> V <sub>1</sub>   | 61.97          | 2.57        | 70.98          | 90.67                | 34.38                | 10.37       | 1.16           | 23.73       | 45.98       | 21.83       |
| H <sub>3</sub> D <sub>3</sub> V <sub>2</sub>   | 61.65          | 2.10        | 58.77          | 86.32                | 35.38                | 11.47       | 1.14           | 21.00       | 37.73       | 20.83       |
| <b>LSD<br/>5%</b>  | <b>1.45</b>    | <b>0.21</b> | <b>2.95</b>    | <b>9.08</b>          | <b>4.41</b>          | <b>1.15</b> | <b>0.20</b>    | <b>0.98</b> | <b>4.60</b> | <b>1.62</b> |

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### التأثير المتكامل للأصناف والكثافة النباتية ومكافحة الحشائش علي المكونات الكيميائية والمحصول ل فول الصويا النامي في الأراضي الجديدة

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اهتم هذا البحث بدراسة تأثير مبيد الحشائش بيوتيرالين (٢,٥ لتر / فدان)، والعزيق عند اعمار ٣٠، ٦٠ يوم من الزراعة مع ثلاث مسافات بين الجور ١٠، ١٥، ٢٠ سم علي التركيب الكيماوي للنبات أثناء النمو والمحصول ومكوناته وأيضا نسبة اليروتين والكريبوهيدرات و الزيت في البذور لصنفي فول الصويا جيزه ١١١ وجيزه ٢١ والحشائش المصاحبة لهما. وأقيمت التجربة في مزرعة دمو بكلية الزراعة جامعة الفيوم خلال موسمي الزراعة ٢٠٠٦، ٢٠٠٧ في تصميم القطع المنشفة مرتين.

وأظهرت النتائج أن كلا من البيوترالين ( $H_2$ ) والعزيق ( $H_3$ ) قد تفوقا علي الكنترول في مقاومة الحشائش في فول الصويا. كانت نسبة تثبيط نمو الحشائش (عريضة وضيقة الأوراق والمجموع الكلي) بتأثير العزيق كان بين (٧٦,٣، ٧١,٣%) وهذا اعلي من الراجع لتأثير البيوترالين (٦٢,٥%) للحشائش ضيقة الأوراق. وكان تأثر الوزن الأخضر للحشائش عريضة الأوراق وأيضا الحشائش الكلية بالكثافة النباتية في العينة الأولى لصالح الكثافة الاعلي ( $D_1$ ) وكانت النسبة ٣٠,٣% و ٣٦,٢% علي الترتيب مقارنة بالمسافة الواسعة بين النباتات ( $D_3$ ) وأظهرت النتائج إن تأثير المسافات بين النباتات اقل من تأثير مقاومة الحشائش ميكانيكيا أو كيماويا علي نمو الحشائش. و لم تظهر الأصناف تأثيرا معنويا. أما التفاعل الثلاثي بين المبيد والمسافة الثانية



والصنف الثاني أو العزيق والمسافة الضيقة مع الصنف الثاني أعطت انخفاضا معنويا في نمو الحشائش ضيقة الأوراق.

أما بالنسبة للتركيب الكيماوي لنبات الفول فكانت معاملة المبيد والعزيق متفوقين علي معاملة الكنترول لصالح معاملة المبيد في معظم التقديرات. وقد تشابهتا في الفينول والكاروتينات والانتوسيانين. لوحظ تأثيرات متداخلة للمسافة بين الجور علي التركيب الكيماوي وتفوقت المسافة ١٥ سم و ١٠ سم.

أعطت التفاعلات بين المبيد مع المسافة الواسعة والمبيد مع المسافة المتوسطة والعزيق مع الصنف الثاني وأيضا التفاعلات الثلاثية مبيد × المسافة الواسعة × الصنف الثاني والعزيق × المسافة ١٠ سم مع الصنف الأول والمبيد مع ١٥ سم مع الصنف الأول أعطوا تأثير موجب عالي علي التركيب الكيماوي لنباتات فول الصويا.

وبالنسبة للمحصول ومكوناته أعطت معاملة العزيق أعلى قيم للمحصول ومكوناته. بينما معاملة المبيد تفوقت في طول النبات فقط. أما المسافة الضيقة ١٠ سم نتج عنها زيادة في عدد الأفرع وعدد القرون ووزن القرون للنبات ووزن بذور النبات ومحصول الفدان وتشابه معها المسافة المتوسطة ١٥ سم في كلا من عدد الأفرع ومحصول الفدان. تفوق الصنف الثاني جيزه ٢١ في المحصول ومكوناته ولكن تميز الصنف الأول جيزه ١١١ بنباتات أطول.

التأثيرات المعنوية للتفاعلات: العزيق مع المسافة والمبيد مع الصنف الثاني والعزيق مع المسافة ١٠ سم مع الصنف الثاني كانت متفوقة ايجابيا في وزن القرون ووزن بذور النبات ودليل البذرة. وكانت أعلى نسبة كربوهيدرات (٢٣,٧٣%) وبروتين (٤٨,١%) وزيت في البذور (٢٢,٣٨%) نتجت من التفاعلات بين العزيق والمسافة الواسعة ٢٠ سم مع الصنف الثاني، المبيد مع المسافة الضيقة مع الصنف الأول، المبيد مع والمسافة الواسعة والصنف الأول علي الترتيب.

وعموما دلت النتائج علي إمكانية الحصول علي محصول عالي للفدان حوالي (١,٨٩٠ طن) من فول الصويا عند زراعة الصنف جيزه ٢١ في الأراضي الجديدة بالمسافة ١٠ سم بين الجور (D<sub>1</sub>) ونباتين في الجوره وإجراء العزيق مرتين أثناء نمو المحصول.