ARCHIVES OF AGRICULTURE SCIENCES JOURNAL

Volume 5, Issue 3, 2022, Pages 1–12

Available online at www.agricuta.edu.eg

DOI: https://dx.doi.org/10.21608/aasj.2022.266402

Response of two soybean (*Glycine max* L.) cultivars to different levels of humic acid and mineral fertilization

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Abstract

The present work was carried out at experimental farm, faculty of agriculture, Al-Azhar University, Assuit, Egypt, during 2020 and 2021 summer seasons, to study response of two soybean (Giza 111 and Giza 22) cultivars to mineral fertilization (NPK); mineral fertilizer at rates 50%, 75% and 100% of the recommended dose of N, P and K (RDF) and humic acid (HA) at rates 0, 6 and 12 kg HA/fed, as soil application. The results indicated that Giza 22 surpassed Giza 111 in seeds yield/feddan (feddan = 4200 m^2), biological yield/feddan and 100- seed weight in both seasons, respectively, as well as oil percentage in first season only and protein percentage in second season only. While Giza 111 surpassed Giza 22 in plant height, number of branches per plant and seeds yield per plant in both seasons, as well as the protein percentage in first season only and oil percentage in second season only. Application recommended dose of mineral fertilization (NPK) at rate 100% led to a significant increase in all traits under study. Using highest level of humic acid, which is 12 kg per feddan (feddan = 4200 m^2), led to a significant increase in all studied traits in this respect. Concerning the interaction between cultivars and mineral fertilization, data focus a significant effect on the characteristics of plant height (cm), seed yield per feddan in both seasons, oil and protein ratio, 100- seeds weight in the first season only, farther biological yield per feddan in the second season only. While the interaction between cultivars and humic acid showed a significant effect on the characteristics of plant height (cm), seed yield per feddan, biological yield per feddan in both seasons, protein percentage, of 100- seed weight in the first season only, and the number of branches per plant in the second season only. Here too, the interaction between mineral fertilization and humic acid also showed a significant effect on the characteristics of seed yield per feddan, biological yield per feddan, weight of 100 seeds, protein percentage in both seasons, plant height and seed yield per plant in the first season only, and the percentage of oil in the seed in the second season only. Finally, the interaction between the three study factors, cultivars, mineral fertilization and humic acid, had a significant effect on the characteristics of the biological yield per feddan in both seasons, seed yield per feddan, weight of 100 seeds in the second season only, while plant height and seed yield per plant in the first season only, respectively.

Keywords: soybean, *Glycine max*, humic acid, mineral fertilization.

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1. Introduction

Egypt is one of the largest countries import oil on the world level, where it is importing more than 90% of the needs of the oil from abroad. Therefore, care must be taken to increase the production of oil crops. Soybean is significant on worldwide level in nourishment and mechanical yields due to high protein content with a dietary benefit industrial crops and nutritional value close to the value of animal protein, (Khalifa and Fakkar, 2020). Soybean contain average protein 40% and oil content 20%, also has the highest protein of all field crops, and is second only to groundnut (*Arachis hypogea*, L) in terms of oil content among food legumes. Recently, soybean and its by-products are being increasingly sought by people who are aware of the healthy benefits of soy-based protein and oil especially in developed countries. According to Leppik (1971), *G. max* is a promising pulse crop proposed for the alleviation of the acute shortage of protein and oil worldwide. Crop production productivity is the basis of certain nutrients for human life, which depends on amount of available nutrient in the soil. To improve the organic contents of soils for growing crops there are some practices must be applied such as planting rotation, various plough techniques, green fertilizer application and animal fertilizer application. In addition to these practices, utilization of organic-mineral fertilizers in agriculture has increased in recent years (Doran *et al.*, 2003). Humic acid is not a fertilizer as it does not directly provide nutrients to plants but is a compliment to fertilizer (El-Bassiouny *et al.*, 2014). Humic acid is rich in carboxyl, hydroxyl, and carbonyl groups as well as in phenols, quinones and semi-quinones (Bravo, 1998; Yoshino, 1998). Humic acids are heterogeneous, which include in the same macromolecule, hydrophilic acidic functional groups and hydrophobic groups. Humic acid hydrophilic groups attract hydration, thus increasing the water retention capacity in soils. Humic acids (HAs) are the main fractions of humic substances (HS) and the most active components of soil and compost organic matter. HAs have been shown to stimulate plant growth and consequently yield by acting on mechanisms involved in cell respiration, photosynthesis, protein synthesis, water and nutrient uptake, enzyme activities (Albuzio *et al.*, 1986; Chen and Aviad, 1990; Chen *et al.*, 2004; Concheri *et al.*, 1994; Vaughan *et al.*, 1985). This action of HA has been demonstrated to be dose dependent and particularly effective in a low concentration range (Chen and Aviad, 1990). One of the used organic mineral fertilizers is humic acid. Humic acid is one of the major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal matter and through the biological activities of microorganisms (Anonymous, 2010). Under water stress, foliar fertilization with humic molecules increased leaf water retention and the photosynthetic and antioxidant metabolism (Fu Jiu *et al.*, 1995). Humic acids were added to an alkaline soil with phosphate fertilizer to wheat grown in field trials. It was observed that phosphate uptake and yield were increased by 25% (Wang *et al.*, 1995). Humic Acid (HA) is the active constituent of organic humus, which can play a very important role in soil conditioning and plant growth, (Bendetti *et al.*, 1996). Soybean (*Glycine max* L.) is among the most important protein and oil crops, where it contains about 40% of protein and 18-22% of cholesterol-free oil, as well as some vitamins (Ghaly *et al.*, 2020; Mahrous *et al.*, 2016; Morokhovets 2016). According to the Ministry of Agriculture and Land Reclamation (MALR), the total production of soybeans reached 25000 tons in Egypt from an area of 9000 hectares (El-Mahdy and Anwar, 2020). The phosphorus (P) element is an essential nutrient for all plants, especially legumes e.g., soybean, where its uptake by soybean plants is essential for proper the majority of oil supplies in Egypt is imported, thus the Egyptian government strategy aims to duplicate the areas for soybeans cultivation. The phosphorus (P) element is an essential nutrient for all plants, especially legumes e.g., soybean, where its uptake by soybean plants is essential for proper nodule formation (Ghaly *et al.*, 2020). Potassium humate (KH) is a humic acid potassium salt, completely water-soluble (Taha *et al.*, 2016). Fulvic (FA) and humic (HA) acids are the major parts of humic materials, where they lead to an increase in soil fertility as well as nutrients availability by increasing the activity of soil organisms and reducing soil pH value, therefore enhancement of plant growth (Farid *et al.*, 2018; Taha and Osman, 2018). Hemida *et al.* (2017) illustrated that KH improved N, P, K, Ca, and vitamin C of snap bean plants compared to untreated plants. Soybeans are one of the world's leading protein components in compound feeds. For humans, soya is also important as an oil source, because soya is the second most important oilseed crop after oil palm. It contains a significant amount of omega 6 and omega 3 fatty acids, which are optimal in dietary terms. Compared to rapeseed oil, soybean oil does not contain erucic acid, which is very positive for human and animal health (Mousavi-Avval *et al.*, 2011; Ramedani *et al.*, 2011). The target of this investigation is to assess the effect of humic acid and mineral fertilization on productivity and quality of soybean. Our goal reducing environmental pollution via lowering mineral fertilization application.

2. Materials and methods

2.1 Experimental site and treatments description

A field experiments were carried out during the two summer seasons of 2020 and 2021 at the experimental farm of the faculty of Agriculture, Al-Azhar University, Assuit, Egypt, to study the effect of three rates of humic acid (0, 6 and 12 kg/feddan) and three NPK fertilizer rates 50, 75 and 100% recommended dose (RDF) the mineral fertilization (N.P.K) were K_2O 48% for K, P_2O_5 15.5% for P and ammonium nitrate 33.5% on productivity and quality of two soybean cultivars (Giza 111 and Giza 22). The performed experiment was designed as randomized complete blocks design in split-split plot arrangement of treatments with three replications. Soybean cultivars were assigned to the main plots, mineral fertilization levels were distributed randomly in the sub plots and humic acid levels were allocated randomly in sub-sub plots. Some physical and chemical properties of the studied soil are presented in Table (1).

Table (1): Some physical and chemical analysis of soil field experiments.

Physical analysis	2020	2021	Chemical analysis	2020	2021
Sand (%)	25.02	25.01	Organic matter (%)	1.24	1.18
Silt (%)	39.63	39.60	Available N (ppm)	84.07	75.51
Clay (%)	35.35	35.39	Available P (ppm)	11.14	11.01
Soil texture	Clay loam		Available K (ppm)	361.21	352.33
			PH	7.98	8.17
			E.C. (ds/m)	1.08	1.01
			Total $CaCO_3$ (%)	3.42	3.18

The experimental unit area was 10.5 m^2 (3×3.5 m), *i.e*., 1/400 feddan (feddan= 4200 m^2). Seeds were inoculated before sowing with an effective strain of *Bradyrhizobium japonicum* and were sown on June 1 and 5 in the first and second seasons, respectively in hills. Thinning was done before the first irrigation to two plants per hill. Calcium super phosphate (15.5% P_2O_5) fertilizer was added before the first irrigation at rates of 50, 75 and 100% recommended dose/feddan (RDF) in both seasons. Ammonia nitrate (33.5% N) fertilizer was added after two weeks of sowing at same rates of calcium super phosphate in both growing seasons. Potassium sulphate (48% K_2O) fertilizer was added before the second irrigation at the same rates of calcium super phosphate in both seasons. While, humic acid (HA) was applied in three levels *i.e*., 0 as a control, 6 and 12 kg per feddan soil application added after two weeks of sown. All the agricultural practices were wear carried out at the recommendations the ministry of agriculture. At harvest, samples of 10 plants were randomly pulled from each plot to estimate the following parameters: plant height (cm), number of branches per plant, seeds yield per plant (g), 100-seed weight (g), seeds yield (ton/feddan), biological yield (ton/feddan), oil percentage and protein (%). Seeds and biological yield per feddan were calculated on the basis of the three middle ridges of the experimental plots and then converted into ton per feddan.

Biological yield is the amount of the substance Total dry matter formed by the plant (Biological yield=Economic yield + Straw yield). For determination of seed oil percentage, soxhelt continuous extraction apparatus was used according to the method described in AOAC (1980). However, nitrogen was determined using improved Kjeldahls method as described in AOAC (1980). Seed protein was calculated by multiplying total nitrogen by 6.25. The obtained data were subjected to proper statistically analysis as described by Gomez and Gomez (1984). Means were compared by using LSD method at 5% level of probability.

3. Results and discussion

3.1 Yield and yield components

3.1.1 Performance of cultivars

The results in Tables (2, 3, 4 and 5) revealed that seeds yield per plant (g), seeds yield (ton/feddan), biological yield (ton/feddan) and 100- seed weight (g) were significantly affected by cultivars in both seasons, while protein percentage and plant height were significantly affected in the first and second seasons only, respectively. The results show that Giza 111 cultivar slightly surpassed Giza 22 cultivar of plant height, number of branches per plant, seeds yield per plant in both seasons, protein percentage in first season only and oil percentage in second season only. However, Giza 22 cultivar slightly surpassed Giza 111 cultivar of biological yield per feddan, seeds yield per feddan, 100- seed weight in both seasons, protein percentage in second season only and oil percentage in the first season only. The differences between the two cultivars may be due to genetic make-up and its interaction with environment conditions. These results are in agreement with those obtained by Husein *et al.* (2006), Soliman *et al.* (2007), Ibrahim (2014) and Safina *et al.* (2018).

3.1.2 Effect of NPK fertilizer

Data in Tables (2, 3, 4 and 5) revealed that all studied traits were significantly affected by mineral fertilization in both seasons. However, data focus that applied recommended dose of mineral fertilization (100% NPK fertilizer) increase of all studied traits. These results may be due to the well-known facts that N.P.K have a major role in photosynthesis activities, energy transfer and carbohydrates metabolism of plants. Moreover, it is a part of the cells, nucleus and it is present in the cytoplasm and its role in cell division is very essential. Similar results were obtained by El-Desoky and El-Far (1996), Al-Jumailly (2007), Mahmoud *et al.* (2011) and Chaturvedi *et al.* (2012).

Table (2): Effect of different levels of humic acid and mineral fertilization on plant height and number of branches per plant of two soybean cultivars in 2020 and 2021 seasons.

Cultivars (A)	NPK levels (B)	Plant height (cm)								Number of branches/plant							
		Humic acid levels (C) kg/feddan								Humic acid levels (C) kg/feddan							
		2020				2021				2020				2021			
		Control	6	12	Mean	Control	6	12	Mean	Control	6	12	Mean	Control	6	12	Mean
Giza 111	50%	77.44	79.33	86.78	81.15	79.00	84.00	85.67	82.89	2.33	2.67	3.33	2.78	2.22	2.56	3.33	2.70
	75%	78.67	83.55	88.45	83.56	82.33	85.67	88.00	85.33	2.33	3.33	3.67	3.11	2.56	3.00	3.56	3.04
	100%	82.45	87.22	91.78	87.15	84.00	87.55	90.44	87.33	2.78	3.67	3.89	3.45	2.78	3.33	4.00	3.37
	Mean	79.48	83.37	89.00	83.95	81.78	85.74	88.04	85.18	2.48	3.22	3.63	3.11	2.52	2.96	3.63	3.04
Giza 22	50%	75.22	77.89	79.33	77.48	75.33	79.12	82.22	78.89	2.00	2.56	3.00	2.52	2.22	2.44	2.78	2.48
	75%	77.33	86.33	89.67	84.44	78.00	81.55	85.00	81.52	2.56	3.22	3.44	3.07	2.44	2.78	3.11	2.78
	100%	82.55	88.56	93.89	88.33	82.33	85.00	90.67	86.00	2.89	3.56	3.67	3.37	2.56	3.33	3.56	3.15
	Mean	78.37	84.26	87.63	83.42	78.55	81.89	85.96	82.14	2.48	3.11	3.37	2.99	2.41	2.85	3.15	2.80
Mean of NPK Levels	50%	76.28	78.61	83.06	79.31	77.17	81.56	83.95	80.89	2.17	2.62	3.17	2.65	2.22	2.50	3.06	2.59
	75%	78.00	84.94	89.06	84.00	80.17	83.61	86.50	83.43	2.45	3.28	3.56	3.09	2.50	2.89	3.34	2.91
	100%	82.50	87.89	92.84	87.74	83.17	86.28	90.56	86.67	2.84	3.62	3.78	3.41	2.67	3.33	3.78	3.26
	Mean	78.93	83.81	88.32		80.17	83.82	87.00		2.48	3.17	3.50		2.46	2.91	3.39	
L.S.D 0.05																	
Cultivars (A)		N.S				Sig				N.S				N.S			
N.P.K Levels (B)		1.030***				0.650***				0.139***				0.126***			
Humic Acid Levels (C)		0.834***				0.573***				0.203***				0.117***			
A×B		1.456***				0.920**				N.S				N.S			
A×C		1.180*				0.810*				N.S				0.166**			
B×C		1.445***				N.S				N.S				N.S			
A×B×C		2.043**				N.S				N.S				N.S			

Table (3): Effect of different levels of humic acid and mineral fertilization on seeds yield per plant and seeds yield per feddan of two soybean cultivars in 2020 and 2021 seasons.

Cultivars (A)	NPK levels (B)	Seeds yield/plant (gm)								Seeds yield (tons/feddan)							
		Humic acid levels (C) kg/feddan								Humic acid levels (C) kg/feddan							
		2020				2021				2020				2021			
		Control	6	12	Mean	Control	6	12	Mean	Control	6	12	Mean	Control	6	12	Mean
Giza 111	50%	22.32	24.03	24.81	23.72	22.99	25.24	25.65	24.63	1.080	1.374	1.482	1.312	1.088	1.331	1.426	1.282
	75%	22.48	25.20	25.54	24.41	24.51	25.73	26.57	25.60	1.208	1.473	1.541	1.407	1.219	1.440	1.540	1.400
	100%	23.59	26.07	27.70	25.79	24.76	26.17	28.60	26.51	1.358	1.536	1.689	1.528	1.346	1.542	1.677	1.522
	Mean	22.80	25.10	26.02	24.64	24.09	25.71	26.94	25.58	1.215	1.461	1.571	1.416	1.218	1.438	1.548	1.401
Giza 22	50%	20.77	23.22	24.63	22.87	21.68	24.11	24.90	23.56	1.114	1.459	1.583	1.385	1.168	1.364	1.453	1.328
	75%	22.09	24.29	25.56	23.98	23.23	25.21	26.09	24.84	1.231	1.529	1.653	1.471	1.241	1.472	1.614	1.442
	100%	22.40	25.57	26.20	24.72	24.23	26.14	26.64	25.67	1.324	1.573	1.773	1.557	1.318	1.581	1.735	1.545
	Mean	21.75	24.36	25.46	23.86	23.05	25.15	25.88	24.69	1.223	1.520	1.670	1.471	1.242	1.472	1.601	1.438
Mean of NPK levels	50%	21.545	23.63	24.72	23.30	22.34	24.68	25.28	24.10	1.097	1.417	1.533	1.349	1.128	1.348	1.440	1.305
	75%	285	75	55	9	7	47	33	22	0	01	97	39	30	56	77	21
	100%	995	82	95	6	0	16	62	09	1	55	31	42	32	62	06	33
	Mean	275	73	74		7	43	41		9	91	20		30	55	74	
L.S.D 0.05																	
Cultivars (A)		Sig				Sig				Sig				Sig			
N.P.K Levels (B)		0.333***				0.312***				0.009***				0.006***			
Humic Acid Levels (C)		0.227***				0.437***				0.009***				0.007***			
A×B		N.S				N.S				0.012***				0.008**			
A×C		N.S				N.S				0.012***				0.010**			
B×C		0.393*				N.S				0.015***				0.012***			
A×B×C		0.555**				N.S				N.S				0.017***			

3.1.3 Effect of humic acid (HA)

Humic acid had significant effect on all studied characters in both seasons (Tables 2, 3, 4 and 5). Humic acid applied 12 kg HA/feddan increase of all studied traits. The enhancing effect of humic acid on NPK concentrations may be due to better development root systems, increased the permeability of plant membranes and humic substances may interact with the phospholipids structures of cell membranes and react as carriers of nutrients through them. These results are agreement with those obtained Mahmoud *et al.* (2011), Safina *et al.* (2018), Bahrun *et al.* (2019) and Nassar *et al*. (2021).

Table (4): Effect of different levels of humic acid and mineral fertilization on biological yield per feddan and 100 seeds weight of two soybean cultivars in 2020 and 2021 seasons.

Cultivars (A)	NPK levels (B)	Biological yield (ton/feddan)								100 seeds weight (gm)							
		Humic acid levels (C) kg/feddan								Humic acid levels (C) kg/feddan							
		2020				2021				2020				2021			
		Control	6	12	Mean	control	6	12	Mean	control	6	12	Mean	control	6	12	Mean
Giza 111	50%	3.209	3.588	3.796	3.531	3.228	3.566	3.807	3.534	12.75	14.05	14.85	13.88	12.17	13.41	13.73	13.10
	75%	3.390	3.798	3.979	3.722	3.403	3.807	4.133	3.781	13.61	14.36	15.10	14.36	12.77	13.54	15.00	13.77
	100%	3.579	3.954	4.331	3.955	3.596	4.073	4.363	4.011	13.95	14.68	15.88	14.84	13.03	14.33	15.50	14.29
	Mean	3.393	3.780	4.035	3.736	3.409	3.815	4.101	3.775	13.44	14.36	15.28	14.36	12.66	13.76	14.74	13.72
Giza 22	50%	3.273	3.686	3.942	3.634	3.332	3.634	3.914	3.627	13.37	14.21	14.85	14.14	12.88	14.10	14.49	13.82
	75%	3.440	3.922	4.139	3.834	3.481	3.860	4.198	3.846	13.74	14.44	15.15	14.44	13.60	14.57	15.14	14.44
	100%	3.586	4.092	4.519	4.066	3.589	4.161	4.454	4.068	14.13	14.54	15.70	14.79	13.97	14.78	16.54	15.10
	Mean	3.433	3.900	4.200	3.844	3.467	3.885	4.189	3.847	13.75	14.40	15.23	14.46	13.48	14.48	15.39	14.45
Mean of NPK levels	50%	3.241	3.637	3.869	3.582	3.280	3.600	3.861	3.580	13.06	14.13	14.85	14.01	12.53	13.76	14.11	13.46
	75%	3.415	3.860	4.059	3.778	3.442	3.834	4.166	3.814	13.68	14.40	15.13	14.40	13.19	14.06	15.07	14.10
	100%	3.583	4.023	4.425	4.010	3.593	4.117	4.409	4.039	14.04	14.61	15.79	14.81	13.50	14.56	16.02	14.69
	Mean	3.413	3.840	4.118		3.438	3.850	4.145		13.59	14.38	15.26		13.07	14.12	15.07	
L.S.D 0.05																	
Cultivars (A)		Sig				Sig				Sig				Sig			
NPK levels (B)		0.008***				0.006***				0.077***				0.185***			
Humic acid levels (C)		0.011***				0.009***				0.102***				0.172***			
A×B		N.S				0.009***				0.109**				N.S			
A×C		0.016***				0.013**				0.144**				N.S			
B×C		0.020***				0.016***				0.176***				0.298***			
A×B×C		0.028**				0.022***				N.S				0.421*			

Table (5): Effect of different levels of humic acid and mineral fertilization on oil percentage and protein percentage of two soybean cultivars in 2020 and 2021 seasons.

Cultivars (A)	NPK levels (B)	Oil percentage (%)								Protein percentage (%)							
		Humic acid levels (C) kg/feddan								Humic acid levels (C) kg/feddan							
		2020				2021				2020				2021			
		Control	6	12	Mean	control	6	12	Mean	Control	6	12	Mean	Control	6	12	Mean
Giza 111	50%	18.56	20.80	22.18	20.51	18.83	20.66	21.68	20.39	33.63	36.86	38.42	36.30	32.69	34.74	35.16	34.20
	75%	19.72	21.00	23.55	21.42	19.41	20.94	22.66	21.00	34.81	38.05	40.61	37.82	33.79	35.39	37.05	35.41
	100%	20.43	21.88	24.36	22.22	19.96	21.18	23.21	21.45	35.30	39.04	41.80	38.71	35.08	36.82	39.34	37.08
	Mean	19.57	21.23	23.36	21.39	19.40	20.93	22.52	20.95	34.58	37.98	40.28	37.61	33.85	35.65	37.18	35.56
Giza 22	50%	19.87	20.94	22.43	21.08	19.61	20.36	21.23	20.40	34.54	36.3	37.67	36.17	32.75	34.46	35.84	34.35
	75%	20.13	21.32	22.98	21.48	19.75	20.87	22.00	20.87	34.97	37.06	38.82	36.95	33.74	35.75	37.06	35.52
	100%	21.16	22.05	23.93	22.38	20.03	21.35	22.77	21.38	35.17	38.1	40.25	37.84	34.93	36.8	39.05	36.93
	Mean	20.39	21.44	23.11	21.65	19.80	20.86	22.00	20.89	34.89	37.15	38.91	36.99	33.81	35.67	37.32	35.60
Mean of NPK levels	50%	19.22	20.87	22.31	20.80	19.22	20.51	21.46	20.40	34.09	36.58	38.05	36.24	32.72	34.60	35.50	34.27
	75%	19.93	16	27	5	8	91	33	94	9	56	72	39	77	57	06	46
	100%	20.80	97	15	0	0	27	99	42	4	57	03	28	01	81	20	00
	Mean	19.98	33	24		0	89	26		4	57	60		83	66	25	
L.S.D 0.05																	
Cultivars (A)		N.S				N.S				Sig				N.S			
N.P.K Levels (B)		0.153***				0.210***				0.228***				0.134***			
Humic Acid Levels (C)		0.317***				0.222***				0.210***				0.192***			
A×B		0.216*				N.S				0.322**				N.S			
A×C		0.449**				0.315**				0.297***				N.S			
B×C		N.S				0.385*				0.364***				0.333***			
A×B×C		N.S				N.S				N.S				N.S			

3.1.4 Interaction effects

The results in tables (2, 3, 4 and 5)

showed that significant interaction effect between cultivars and mineral fertilization (NPK) levels on 100-seed weight, oil percentage and protein percentage in the first season as well as biological yield per feddan in the second season and seeds yield per feddan and plant height in both seasons. The highest of seeds yield (1.557 and 1.545 ton/feddan) was produced by Giza 22 cultivar and 100% NPK fertilizer in first and second seasons, respectively. The interaction between cultivars and humic acid had significant affected on plant height, seeds yield (ton/feddan), biological yield (ton/feddan) and oil percentage in both seasons and 100- seed weight and protein percentage in the first season only and number of branches per plant in the second season only, respectively Tables (2, 3, 4 and 5). The highest seed yield (1.670 and 1.601 ton/feddan) as recorded for Giza 22 cultivar with humic acid level (12 kg/feddan) in the first and second seasons, respectively. The interaction effect between NPK fertilizer levels and humic acid levels in Tables (2, 3, 4 and 5), was significant effect on seeds yield per feddan, biological yield per feddan, 100- seed weight and protein percentage in both seasons, plant height and seeds yield per plant in the first season only and oil percentage in the second season only. The interaction among cultivars, mineral fertilization (NPK levels) and humic acid levels had significant effect on biological yield per feddan in both seasons and plant height and seeds yield per plant in the first season only and seeds yield per feddan and 100- seed weight in the second season only. Were Giza 22 cultivar, 100% NPK fertilizer and 12 kg humic acid gave the best results in the biological yield and seed yield per feddan in both seasons gave the value (4.519 and 4.454 ton/feddan) and (1.773 and 1.735 ton/feddan) in the first and second seasons, respectively.

4. Conclusion

The conclusion from the research. The highest seed yield per feddan from planting soybean Giza 22 cultivar and 100% of the recommended dose of (NPK) and rate 12 kg HA/feddan as soil application under Assuit governorate conditions, Egypt.

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