The Response of some Cultivars of Green Cowpea grown in the Desert region to Pinching and Spraying with Cobalt

Sabah Hassan Ouda
College of Agriculture, University of Basrah, Iraq
Email: Sabah.ouda25@uobasrah.edu.iq

Abdulla A. Abdulla
College of Agriculture, University of Basrah, Iraq
Email: Abdulla.abdulaziz@uobasrah.edu.iq

Abstract

The experiment was conducted during the summer season of 2024 at the Protected Agriculture Division of the Basrah Agriculture Directorate in Khor Al-Zubair, southern Basrah province. The study aims to investigate the effect of variety, apical bud pinching, and cobalt foliar spraying on the growth and yield of cowpea plants. A factorial split-split plot experiment was carried out using a Randomized Complete Block Design (R.C.B.D.) with three replications. The results showed that the Dutch variety significantly outperformed others in leaf chlorophyll, carbohydrate, and cobalt contents, recording (13.75 mg $100g^{-1}$ fresh weight), (548.5 mg $100g^{-1}$ dry weight), and (4.23 µg g^{-1}), respectively. The local variety excelled at the total of flower number, the total of green pod yield, and the total of fresh seed yield, recording averages of (37.17 flowers $plant^{-1}$), (8.967 ton ha^{-1}), and (124.7 g $plant^{-1}$), respectively. Apical bud pinching significantly affected the total of flowers number, green pod yield, and fresh seed yield, yielding (36.00 flowers $plant^{-1}$), (8.620 ton ha^{-1}), and (109.2 g $plant^{-1}$) respectively. Cobalt foliar spray at 8 mg L^{-1} caused a significant increase in floral and chemical traits and yield components, including total flowers, fruit set percentage, , green pod yield, fresh seed yield and the content of chlorophyll and cobalt, recprding (35.56 flowers $plant^{-1}$), (80.44%), $^{-1}$), (8.632 ton ha^{-1}), (108.7 g $plant^{-1}$), (13.80 mg $100g^{-1}$ fresh weight), and (5.17 µg g^{-1}) respectively. Meanwhile, spraying at 4 mg L^{-1} significantly increased carotene (0.0228 mg $100g^{-1}$ fresh weight) and carbohydrate content (508.4 mg $100g^{-1}$ dry weight). Some two and three combinations showed significant effects on the studied traits.

Keywords: Cowpea, varieties, apical bud pinching, cobalt foliar spray, growth, yield, desert region.

Introduction .

Cowpea (*Vigna unguiculata* L. Walp) is one of the most important crops in the legume family (Fabaceae) and is a vegetable plant that requires a warm climate to grow. Africa is considered its orgin place , from where spread to Asia and other regions [4]. Cowpea is an important food source due to its nutritional value, 100 grams of cowpea seeds contain 11 g of water, 338 calories, 22.5 g of protein, 1.4 g of fat, 61 g of carbohydrates, 2.0 g of fiber, 104 mg of calcium, 416 mg of phosphorus, 0.08 mg of vitamin B1 (thiamine), 0.9 mg of vitamin B2 (riboflavin), 0.4 mg of vitamin B3

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(niacin), and 2.0 mg of vitamin C ascorbic acid [17].

In Iraq, cowpea cultivation is mainly concentrated in the central and northern regions. In 2023, the cultivated area approximately reached to 26,324Tons ha^{-1} with a total production of 14,112 tons and an average yield of 8,576 Tons ha^{-1} [22].

Selecting the appropriate variety usually depending on genetic differences in morphological and physiological traits and due to its ability to adapt to environmental and climatic conditions. When two cowpea varieties, Albina and Uno, were grown under indonesian conditions, the Uno variety showed a significant increase in the total number of flowers (24.79 flowers per plant) compared to Albina, which produced fewer flowers [19].

studied four cowpea varieties (Black Eye, Ramshorn, Local, and Rahawiya) and found that the Local variety outperformed the others in total yield, reaching 94.20 tons per hectare [5] .

It is essential to establish certain agronomic practices that ensure the availability of adequate nutrients for both vegetative and reproductive parts, reduce apical dominance, and improve yield and quality. Pruning the growing tips of PDKV cowpea plants 30 days after planting resulted in a significant increase in the total number of flowers and green pod yield compared to unpruned plants[12].

In a study on the effect of pruning on fenugreek (*Trigonella foenum-graecum* L.) at three stages (no pruning, 25 days, and 35 days after planting), pruning caused significant differences among treatments. The 35-day pruning stage showed superiority in several yield traits, including seed yield per plant and per hectare, recording the highest productivity rates of 3.44 g per plant and 1,148.11 kg per hectare, respectively, compared to the control and 25-day pruning treatments [18].

Cobalt is considered the one of essential micronutrients that involve in the formation of root nodules in legumes, due to its role in atmospheric nitrogen fixation. It also contributes to photosynthesis and increases yield components such as the number of pods, dry matter, and seed production. However, when added in high concentrations, it negatively affects physiological, biochemical, and biological processes throughout the plant's life cycle, hindering its growth

[23].

Materials and Methods

The experiment was conducted during the summer season of 2024 in the Protected Agriculture Division of the Directorate of Agriculture in Basra Governorate, located in Khor Al-Zubair, southern of Basra. The objective was to study the effect of apical pruning and foliar spraying with cobalt on the growth and yield of some green cowpea varieties that grown in a desert area. The field was prepared by plowing, smoothing, leveling the soil and designing into nine ridges with 24.10 meters long for each... Each ridge divided into six experimental units with 3.60 meters in length . The total number of experimental units was 54, Each unit contained 24 plants. The distance between adjacent experimental units was 50cm, with 1 meter between ridges and 30 cm between plants. Post the field prapertion, seeds were sown on August 5, 2024.Soil samples were collected and analyzed in the labortary of Soil and Water Resources Department, College of Agriculture, University of Basrah, as shown in Table (1).The experiment was conducted using a Randomized Complete Block Design (R.C.B.D.) according to the method of [8], with three replications in a split-split plot factorial experiment. The varieties (Local, American, and Bayader Dutch) represented the main plots, the sub-plots were the apical pruning treatments (pruning after 4–5 true leaves), and the sub-sub plots were the cobalt spray concentrations (0, 4, and 8 mgL^{-1}). The plants were sprayed with cobalt in three applications: the first at 30 days after planting and the subsequent two sprays at 10-day intervals.The studied traits included photopigments total chlorophyll and carotenoids estimated in leaves of untreated and treated plants after 60 days of seeds cultivation was estimated according to the method described by [16]. The content of carbohydrates and cobalt was measured using the method of [15] and [9] respectively. Physical and productivity traits including total number of flowers, pod setting percentage, total green pod yield (Tons ha^{-1}), an d seed yield per plant (fresh weight) were accurately assessed.The data were statistically analyzed according to the experimental design using the GenStat software, and the means were compared using the Least Significant Difference (L.S.D.) test at the 0.05 probability level.

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Table(1). Selected chemical and physical properties of the experimental field soil and irrigation water.

Soil Property	Unit	Value
Electrical conductivity (EC)	dS m^{-1}	5.22
Soil pH	-	8.15
Total nitrogen	g kg^{-1}	0.1
Available nitrogen	mg kg^{-1}	99.33
Available phosphorus	mg kg^{-1}	13
Available potassium	mg kg^{-1}	125.16
Total carbonates	g kg^{-1}	290.78
Sulfates	mmol L^{-1}	60.24
Organic matter	g kg^{-1}	1.76
Sand	g kg^{-1}	827.10
Silt	g kg^{-1}	38.14
Clay	g kg^{-1}	134.76
Soil Texture	-	Sandy loam
Irrigation water EC	dS m^{-1}	5.62
Irrigation water pH	-	7.26

Results and Discussion.

It is evident from Table (2) that the factors of variety and cobalt foliar spraying caused significant differences in the leaf content of chlorophyll and carotene, except that the variety factor did not significantly affect carotene pigment, and apical pinching had no significant effect on photopigments. The Dutch variety recorded the highest chlorophyll content, reaching 13.75 mg $100g^{-1}$ fresh weight, compared to the local and American varieties, which gave 12.63 and 12.47 mg $100g^{-1}$ fresh weight, respectively. The differences among varieties may be attributed to genetic factors which particularly impact on their tolerance variation in tolerance to salinity and environmental stresses. These findings agree with those reported by [11] and [24].

The cobalt foliar spray also had a significant effect, where the 8 mg L^{-1} concentration produced the highest chlorophyll content (13.93 mg $100g^{-1}$

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fresh weight) compared to the control and 4 mg L^{-1} concentration, which recorded 12.16 and 11.12 mg $100g^{-1}$ fresh weight, respectively. Meanwhile, the cobalt spray significantly affected carotene content at 4 mg L^{-1}, which gave the highest value (0.0228 mg $100g^{-1}$ fresh weight) compared to the lower values at other concentrations (0.0210 and 0.0205 mg $100g^{-1}$ fresh weight. This increase can be attributed to the importance of cobalt in atmospheric nitrogen fixation and its role in stimulating nitrate reductase enzymes, which enhance nitrogen availability and root uptake. Consequently, this increases photosynthetic activity, providing greater quantities of essential and accessory pigments such as chlorophyll and carotene, resulting in higher photopigment levels in the leaves [3]. These results agree with those of [25].and [2]. From the same table , it can be observed that two-way interactions had significant effects except for the interaction between varieties and pinching, which was not significant. The American variety sprayed with 8 mg L^{-1} cobalt showed the highest chlorophyll content in their leaves (14.45 mg $100g^{-1}$ fresh weight), while unsprayed American varity plants recorded the lowest value (11.41 mg $100g^{-1}$ fresh weight). Similarly, the American variety sprayed with 4 mg L^{-1} cobalt produced the highest leaves content of carotene (0.0232 mg $100g^{-1}$ fresh weight), whereas the lowest value was observed at 8 mg L^{-1} for the same variety (0.0185 mg $100g^{-1}$ fresh weight. The leaves of plants that sprayed with 8 mg L^{-1} cobalt and not pinched recorded the highest chlorophyll content (14.59 mg $100g^{-1}$ fresh weight), while unsprayed and unpinched plants had the lowest content of chlorophyll in their leaves (11.36 mg $100g^{-1}$ fresh weight). The interaction between pinching and spraying showed that unpinched plants sprayed with 4 mg L^{-1} cobalt produced the highest carotene content in their leaves (0.0232 mg $100g^{-1}$ fresh weight) compared to unpinched and unsprayed plants, which gave the lowest value (0.0204 mg $100g^{-1}$ fresh weight As for the three-way interaction, unpinched American variety plants sprayed with 8 mg L^{-1} cobalt had the highest chlorophyll content in their leaves (15.16 mg)$100g^{-1}$ fresh weight), while the local variety plants that were neither sprayed nor pinched recorded the lowest value (9.68 mg $100g^{-1}$ fresh weight). Additionally, the leaves of unpinched and 4 mg L^{-1} cobalt-sprayed plants of American varity recorded the highest carotene content (0.0238 mg $100g^{-1}$ fresh weight), whereas the lowest carotene value (0.0179 mg $100g^{-1}$ fresh weight) was observed in the leaves of local variety plants that were nerther sprayed nor pinched.

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Table (2): Effect of Cultivars, Apical Pruning, Cobalt Foliar Application, and TheirInteractions on Leaf Content of photopigments.

Cultivars	Pinching Operation	Chlorophyll mg $100g^{-1}$ fresh weight,			Interaction between Cultivars and Pinching	Carotene mg $100g^{-1}$ fresh weight,			Interaction between Cultivars and Pinching
		Cobalt element concentrations mg L-1				Cobalt element concentrations mg L-1			
		0	4	8		0	4	8	
Local	No Pinching	9.680	11.673	12.463	11.272	0.0179	0.0226	0.0232	0.0212
	Pinching	13.330	14.023	13.700	13.684	0.0194	0.0224	0.0199	0.0206
American	No Pinching	10.553	11.243	15.160	12.319	0.0219	0.0238	0.0185	0.0214
	Pinching	12.393	12.717	13.730	12.947	0.0231	0.0227	0.0186	0.0215
Dutch	No Pinching	13.853	12.880	14.553	13.762	0.0214	0.0233	0.0197	0.0214
	Pinching	12.393	12.717	13.730	13.738	0.0222	0.0223	0.0230	0.0225
L.S.D 0.05			1.575		NS		0.0014		NS
					Cultivar Mean				Cultivar Mean
Interaction Effect between Cultivars and Spraying	Local	11.505	12.848	13.082	12.478	0.0186	0.0225	0.0215	0.0209
	American	11.473	11.980	14.445	12.633	0.0225	0.0232	0.0185	0.0214
	Dutch	13.523	13.460	14.267	13.750	0.0218	0.0228	0.0213	0.0220
L.S.D 0.05			0.888		0.707		0.0009		NS
					Pinching Mean				Pinching Mean
Effect of Interference between Earring and Spray	No Pinching	11.362	11.932	14.059	12.451	0.0204	0.0232	0.0204	0.0213
	Pinching	12.972	13.593	13.803	13.456	0.0215	0.0224	0.0205	0.0215
L.S.D 0.05			1.116		NS		0.0008		NS
Spraying Mean		12.167	12.763	13.931		0.0210	0.0228	0.0205	
L.S.D 0.05			0.498				0.0004		

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It is clear from Table (3) that the factors of variety and cobalt foliar spraying had a significant effect on the leaf content of carbohydrates and cobalt. The varieties showed significant differences, as the Dutch variety gave the highest averages — 538.8 mg 100g^{-1} dry weight and 4.23 µg g^{-1} — compared to the American and local varieties, which recorded lower values of 430.3 and 359.0 mg 100g^{-1} dry weight, and 3.91 and 3.50 µg g^{-1}, respectively. Foliar spraying with cobalt at concentrations of 4 and 8 mg L^{-1} produced higher carbohydrate contents in the leaves (508.4 and 490.9 mg 100g^{-1} dry weight) compared to the control (328.8 mg 100g^{-1} dry weight). In contrast, apical pinching had no significant effect on the either trait

Cobalt spraying at 8 mg L^{-1} caused a significant increase in the leaf cobalt concentration, reaching 5.17 µg g^{-1}, compared to 4.33 and 2.14 µg g^{-1} of the 4 mg L^{-1} and control-treated plants, respectively. The plants sprayed with 4 mg L^{-1} treatment also significantly exceeded the control. This increase may be attributed to cobalt's role in facilitating the uptake of macronutrients, particularly nitrogen, which contributes to chlorophyll formation and enhances photosynthetic efficiency. Consequently, greater accumulation of assimilates occurs in the leaves, leading to improved vegetative growth. These findings are consistent with those of [13].

Two-way interactions showed significant effects for both traits, except for the interaction between varieties and pinching in the leaves cobalt content. The interaction between varieties and pinching revealed that the pinched Dutch variety had the highest carbohydrate content in their leaves (548.4 mg 100g^{-1} dry weight), while the unpinched American variety recorded the lowest content of carbohydrates in their leaves (307.4 mg 100g^{-1} dry weight).

Regarding the interaction between varieties and cobalt spraying, the Dutch variety sprayed with 8 mg L^{-1} cobalt recorded the highest values — 748.2 mg 100g^{-1} dry weight and 5.82 µg g^{-1} — whereas the American variety sprayed at the same concentration showed the lowest leaves carbohydrate content (197.9 mg 100g^{-1} dry weight). The unsprayed local variety also gave the lowest leaves cobalt content (1.94 µg g^{-1}).

For the interaction between pinching and cobalt spraying, a significant effect on carbohydrates was observed. Pinched plants sprayed with 4 mg L^{-1} cobalt had the highest leaves carbohydrate content (513.9 mg 100g^{-1} dry weight) compared to unpinched and unsprayed plants (284.2 mg 100g^{-1} dry weight). Similarly, pinched plants sprayed with 8 mg L^{-1} cobalt had the highest leaves cobalt content (5.26 µg g^{-1}), while unpinched and unsprayed plants had the lowest value (1.94 µg g^{-1}).

The three-way interaction among the studied factors also showed significant differences. The Dutch variety, without pinching and sprayed with 8 mg L^{-1} cobalt, recorded the highest leaves carbohydrate content (849.6 mg 100g^{-1} dry weight), while the American variety, with pinching and sprayed with 4 mg L^{-1} cobalt, gave the lowest value of carbohydrates in their leaves (169.2 mg 100g^{-1} dry weight)

As for leaf cobalt content, the pinched local variety sprayed with 8 mg L^{-1} cobalt recorded the highest level (6.22

μg g^{-1}), whereas the unpinched and unsprayed American variety showed the lowest leaves cobalt content (1.60 μg g^{-1})

Table (3): Effect of Cultivars, Apical Pruning, Cobalt Foliar Application, and Their Interactions on Leaf Content of Carbohydrates and Cobalt.

Cultivars	Pinching Operation	Carbohydrates mg $100g^{-1}$ dry weight, Cobalt element concentrations mg L-1: 0	4	8	Interaction between Cultivars and Pinching	Cobalt μg g^{-1}, Cobalt element concentrations mg L-1: 0	4	8	Interaction between Cultivars and Pinching
Local	No Pinching	319.7	578.7	438.7	445.7	1.740	4.127	4.503	3.457
	Pinching	461.4	169.2	614.5	415.0	2.127	4.167	4.377	3.557
American	No Pinching	325.4	400.0	196.8	307.4	1.603	4.520	5.380	3.834
	Pinching	391.4	641.3	199.0	410.6	2.590	4.233	5.147	3.990
Dutch	No Pinching	207.6	530.4	849.6	529.2	2.477	4.777	5.377	4.210
	Pinching	267.5	731.2	646.8	548.5	2.343	4.183	6.263	4.263
L.S.D 0.05			93.53		47.81		0.441		NS
					Cultivar Mean				Cultivar Mean
Interaction Effect between Cultivars and Spraying	Local	390.5	373.9	526.6	430.3	1.933	4.147	4.440	3.507
	American	358.4	520.6	197.9	359.0	2.097	4.377	5.263	3.912
	Dutch	237.5	630.8	748.2	538.8	2.410	4.480	5.820	4.237
L.S.D 0.05			56.46		32.99		0.334		
					Pinching Mean				Pinching Mean
Effect of Interference between Earring and Spray	No Pinching	284.2	503.0	495.0	427.4	1.940	4.474	5.087	3.834
	Pinching	373.4	513.9	486.8	458.0	2.353	4.194	5.262	3.937
L.S.D 0.05			63.78		NS		0.246		NS
Spraying Mean		328.8	508.4	490.9		2.147	4.334	5.174	
L.S.D 0.05			42.00				0.174		

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Table (4) indicates that the three studie

factors variety, apical bud pinching, and cobalt foliar spraying caused significant differences in the total number of flowers. The local variety recorded the highest mean value (37.17 flowers plant⁻ ¹) compared to Dutch and American varieties, which recorded lower averages of 34.11 and 31.56 flowers plant⁻ ¹, respectively. The Dutch variety also outperformed the American variety, reaching 34.11 flowers plant⁻ ¹, which may be attributed to genetic factors and the ability of varites to tolerate surrounding environmental

conditions [6]. These results agree with the findings of [19].

The apical bud pinching treatment also resulted in a higher number of flowers per plant (36.00 flowers plant⁻ ¹) compared to unpinched plants (32.56 flowers plant⁻ ¹). Similarly, cobalt foliar spraying at 4 and 8 mg L⁻ ¹ caused significant increases in the flower number, recording 35.56 and 34.22 flowers plant⁻ ¹, respectively, compared to the control treatment, which gave the lowest value (33.06 flowers plant⁻ ¹).

As for fruit set percentage, the factors of variety and apical pinching did not show significant effects. However, plants treated with cobalt at 8 mg L⁻ ¹ Lproduced the highest fruit set percentage (80.44%) compared to 4 mg L⁻ ¹ and the control-treated plants which recorded 75.50% and 72.03%), respectively.

Two-way interactions did not show significant differences for either trait, except for the interaction between variety and pinching in fruit set percentage. The unpinched local variety recorded the highest fruit set (81.08%), while the unpinched Dutch variety gave the lowest value (71.22%).

The three-way interaction among the studied factors did not show any significant effect on either the total

number of flowers or the fruit set percentage

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Table (4): Effect of Cultivars, Apical Pruning, Cobalt Foliar Application, and Their Interactions on the Total number of flowers and fruit set percentage.

Cultivars	Pinching Operation	Total number of flowers			Interaction between Cultivars and Pinching	fruit set percentage.(%)			Interaction between Cultivars and Pinching
		Cobalt element concentrations mg L-1				Cobalt element concentrations mg L-1			
		0	4	8		0	4	8	
Local	No Pinching	33.67	34.67	36.67	35.00	74.23	81.33	87.67	81.08
	Pinching	39.33	38.33	40.33	39.33	70.33	73.00	78.33	73.89
American	No Pinching	26.00	30.00	31.33	29.11	72.97	72.67	81.33	75.66
	Pinching	33.00	35.00	34.00	34.00	70.33	73.33	81.00	74.89
Dutch	No Pinching	30.33	34.33	36.00	33.56	68.33	70.67	74.67	71.22
	Pinching	36.00	33.00	35.00	34.67	76.00	82.00	79.67	79.22
L.S.D 0.05			NS		NS		NS		6.731
					Cultivar Mean				Cultivar Mean
Interaction Effect between Cultivars and Spraying	Local	36.50	36.50	38.50	37.17	72.28	77.17	83.00	77.48
	American	29.50	32.50	32.67	31.56	71.65	73.00	81.17	75.27
	Dutch	33.17	33.67	35.50	34.11	72.17	76.33	77.17	75.22
L.S.D 0.05			NS		1.825	1.825	1.825		NS
					Pinching Mean				Pinching Mean
Effect of Interference between Earring and Spray	No Pinching	30.00	33.00	34.67	32.56	71.84	74.89	81.22	75.99
	Pinching	36.11	35.44	36.44	36.00	72.22	76.11	79.67	76.00
L.S.D 0.05			NS		1.527		NS		NS
Spraying Mean		33.06	34.22	35.56		72.03	75.50	80.44	
L.S.D 0.05			2.11				3.790		

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Table (5) shows that the three studied factors variety, apical bud pinching and cobalt foliar spraying had significant effects on the total green pod yield and fresh seed yield.

The local variety produced the highest values, recording (8.967 tons ha^{-1}) and (124.7 g $plant^{-1}$), compared to the American and Dutch varieties which gave lower yields of (7.758 and 8.410 tons ha^{-1}), and (86.8 and 98.4 g $plant^{-1}$), respectively. This superiority may be attributed to genetic factors influencing the physiological processes of the crop, including the efficient translocation of nutrients and assimilates from the leaves to yield components, thereby enhancing productivity [5].These findings are consistent with the results that reported by [14].and [1].

The apical bud pinching treatment also had a significant effect, as pinched plants recorded higher averages(8.620 tons ha^{-1}) and (109.2 g $plant^{-1}$) compared to unpinched plants (8.137 tons ha^{-1}) and (97.4 g $plant^{-1}$). This positive effect of pinching may be related to the improved vegetative growth, better distribution of nutrients within the plant, and enhanced physiological activity that increases the efficiency of photosynthesis and consequently improve the yield per unit area[21] and [20].

Similarly, cobalt foliar spraying at 8 mg L^{-1} significantly increased total yield, reaching (8.632 tons ha^{-1}), compared to control and 4 mg L^{-1}-traeted plants, which produced (8.138 and 8.365 tons ha^{-1}), respectively. The highest fresh seed yield was obtained from plants sprayed with cobalt at 4 and 8 mg L^{-1}, recording (104.9 and 108.7 g $plant^{-1}$), respectively, compared to the untreated plants (96.4 g $plant^{-1}$).

This result confirms the importance of cobalt and its positive influence on the activity of Rhizobium bacteria in nitrogen fixation by stimulating the enzymes involved in vitamin B_{12} synthesis. Cobalamin enhances nitrogen assimilation and improves yield characteristics, resulting increases the efficiency of production [7].These findings are in agreement with those published by [10].

No significant effects were observed for two-way or three-way interactions, except for a significant three-way interaction on total green pod yield. The pinched local varietythat sprayed with 8 mg L^{-1} cobalt produced the highest yield(9.752 tons ha^{-1}), while the unpinched and unsprayed American varietyobtained the lowest value (7.336 tons ha^{-1}).

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Table (5): Effect of Cultivars, Apical Pruning, Cobalt Foliar Application, and Their Interactions on the total yield of green pods and the fresh seed yield per cowpea plant.

Cultivars	Pinching Operation	total yield of green pods tons ha⁻ ¹)			Interaction between Cultivars and Pinching	fresh seed yield per cowpea plant g plant⁻ ¹			Interaction between Cultivars and Pinching
		Cobalt element concentrations mg L-1				Cobalt element concentrations mg L-1			
		0	4	8		0	4	8	
Local	No Pinching	8.542	8.608	8.902	8.684	106.5	134.0	120.9	120.5
	Pinching	8.680	9.319	9.752	9.250	114.0	132.0	140.8	128.9
American	No Pinching	7.336	7.500	7.830	7.555	71.2	77.3	90.7	79.7
	Pinching	7.881	7.988	8.013	7.960	98.9	87.0	95.6	93.8
Dutch	No Pinching	7.892	8.224	8.396	8.871	85.3	96.0	94.5	92.0
	Pinching	8.497	8.552	8.900	8.650	102.1	103.2	109.5	104.9
L.S.D 0.05			0.370		NS		NS		NS
					Cultivar Mean				Cultivar Mean
Interaction Effect between Cultivars and Spraying	Local	8.611	8.963	9.327	8.967	110.3	133.0	130.8	124.7
	American	7.609	7.744	7.921	7.758	85.1	82.1	93.1	86.8
	Dutch	8.194	8.388	8.648	8.410	93.7	99.6	102.0	98.4
L.S.D 0.05			NS		0.269		NS		11.21
					Pinching Mean				Pinching Mean
Effect of Interference between Earring and Spray	No Pinching	7.924	8.111	8.376	8.137	87.7	102.4	102.0	97.4
	Pinching	8.352	8.619	8.889	8.620	105.0	107.4	115.3	109.2
L.S.D 0.05			NS		0.096		NS		5.87
Spraying Mean		8.138	8.365	8.632		96.4	104.9	108.7	
L.S.D 0.05			0.148				7.20		

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Conclusion

Selecting a suitable variety, performing apical bud pinching, and spraying cobalt at 8 mg L^{-1} (three sprays—the first at 30 days after planting, followed by two sprays at 10-day intervals) significantly enhanced the growth and yield of green cowpea under the desert conditions of southern Iraq.

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