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EFFECT OF PENDIMETHALIN AND IAA TREATMENTS ON GROWTH, YIELD, CHEMICAL COMPOSITION OF COWPEA (*Vigna sinensis* L.) AND ASSOCIATED WEEDS AT NOBARYA

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ABSTRACT

Two field experiments were conducted at the newly reclaimed sandy soil of Nobarya in 1998 and 1999 seasons to study the effect of using the herbicide Pendimethalin (Stomp) at the rate of (0.0, 0.9 and 1.7 L/fed.) and IAA at (0.0, 12.5 – 25.0 and 50.0 ppm) as well as their different combinations on associated weeds, plant growth and yield components of cowpea plants in addition to the chemical composition of seeds. Pendimethalin alone or in combination with IAA significantly depressed the growth of weeds as compared with untreated plants. Treatment of Pendimethalin at the rate of (1.7 L/fed.) + IAA at (25 ppm) was effective in depressing the fresh and dry weight of total weeds at 50 and 75 days after sowing followed by Pendimethalin (0.9 L/fed.) + IAA at (25 ppm). On the other hand, IAA treatments alone were less effective. All Pendimethalin and IAA treatments caused significant increase in plant growth and yield characters. The results showed that the plant height, No. of leaves, branches, No. of pods, seed, dry weight of plant yield/plant, weight of 100 seed and seed yield (kg/fed.) were significantly increased by the application of Pendimethalin and IAA than the control treatment which produced the lowest values of seed yield. Total protein %, carbohydrate % as well as the content of N, P, K, Zn and Mn in cowpea seeds were increased by all treatments. The highest increase was recorded by Pendimethalin at (1.7 L/fed.) + IAA at (25 ppm).

INTRODUCTION

Cowpea (*Vigna sinensis* L.) is a popular leguminous crop in Egypt. Therefore it was thought advisable to cultivate this crop in the newly reclaimed soil. There is no doubt that weed control treatments as well as using plant growth promoters would be a helpful practice in this regions.

Weeds are one of the major factors affecting cowpea production. Hand hoeing is still the common practice for controlling cowpea weeds. The expensive and rare of hand labour in this regions resulted in the necessity of using herbicides.

One of the most promising pre-emergence herbicide for weed control in leguminous crops is Pendimethalin at the rate of 1.0 L/fed. (Carson 1979; Dubey *et al.*, 1991). An effective weed control treatment in *Vigna* sp. was reported by Egunjabi and Adegake (1990) who mentioned that pre-sowing incorporation of Pendimethalin increased seed yields of cowpea. Kumar and Kairon (1991) and El-Quesni *et al.* (1993) found that Pendimethalin was effective against weeds and also increased yield.

In recent years, several growth regulators have been tried to increase crop tolerance against different stress conditions such as water deficiency in sandy soil and hence stimulate plant growth. Ogbonna and Abraham (1989) reported that spraying cowpea with IAA markedly increased the nutritional value of both straw and seeds.

The aim of this work is to get further information about the role of IAA in minimizing the physiological stresses of cowpea plants grown in the newly reclaimed soils induced by the lack of mineral nutrients as well as the use of herbicides.

MATERIALS AND METHODS

Two field experiments were conducted at the newly reclaimed sandy soil of Nobarya during the two successive growing seasons of 1998 and 1999. The soil characteristics of the experimental sit is presented in Table (1). Analysis of the soil was done according to Jackson (1960). The experiments included 12 treatments with four replicates arranged in a randomized complete design. The plot area was (7.2 m^2) and included 3 rows (4 m. X 60 cm.).

The treatments were as follows :

1. Unweeded control.
2. IAA (Indole 3 acetic acid) as foliar spray at the rate of (12.5 ppm).
3. IAA as foliar spray at the rate of (25 ppm).
4. IAA as foliar spray at the rate of (50 ppm).
5. Pendimethalin N-Cl-ethyl-propyl)-3,4 Aimethyl 2-6-dimitrobenzamine at the rate of 0.9 L/fed.
6. Pendimethalin at the rate of (0.9 L/fed.) + IAA (12.5 ppm).
7. Pendimethalin at the rate of (0.9 L/fed.) + IAA (25 ppm).
8. Pendimethalin at the rate of (0.9 L/fed.) + IAA (50 ppm).
9. Pendimethalin at the rate of (1.7 L/fed.).
10. Pendimethalin at the rate of (1.7 L/fed.) + IAA (12.5 ppm).
11. Pendimethalin at the rate of (1.7 L/fed.) + IAA (25 ppm).
12. Pendimethalin at the rate of (1.7 L/fed.) + IAA (50 ppm).

Table (1) : Mechanical and chemical analyses of Nobarya soil before executing the experiment.

Components	Value
Mechanical analyses :	
Soil fraction :	
Sand %	75.6
Sit %	17.4
Clay %	5.5
Texture class	Sandy
Chemical analyses :	
PH	7.9
E.C.	0.11 mmhos/cm.
CO_3	-
HCO_3	2.5 meq/100 g. soil
Cl^-	1.0 meq/100 g. soil
Ca^{+2}	2.5 meq/100 g. soil
Mg^{+2}	1.0 meq/100 g. soil
Na	1.3 meq/100 g. soil
K^+	0.05 meq/100 g. soil
Total nitrogen	350 ppm

m.equivalent/100 g. soil.

The herbicidal treatment was added pre-planting to the soil whereas IAA was sprayed after 35 days from sowing.

Seeds of cowpea *Vigna sinensis* L. were secured from legume research Dept., A.R.C. and inoculated with strain of cowpea Rhizobia and sown on April 26 the of 1998 and 1999 seasons).

The field was fertilized with calcium super-phosphate (15.5 % P_2O_5) at a rate of 100 kg/fed. and potassium sulphate (48.5 % K_2O) at a rate of 100 kg/fed. during the preparation of the soil. Ammonium nitrate (33.5 %) at the rate of 80 kg/fed. in two equal portion was applied before the first and second irrigation. The normal cycle for irrigation cowpea plants was followed.

Data recorded :

On weeds :

Weeds were hand pulled randomly from one square meter from each plot after 50 and 75 days from sowing and identified and classified to broad-leaved and grasses. Fresh weight (gm./m²) of each group was recorded and the dry weight of weeds was determined after drying in a forced draft oven at 70°C till constant weight was obtained.

During the growth season samples from each treatment were taken 75 day after sowing. In each sample plant height, number of leaves, number of branches, number of pods/plant and dry weight of the plant were determined. The total weight of seeds/plant and total yield kg/fed. and seed index were recorded for each treatment. Samples were taken from each replicate, dried, ground and analyzed for P, K, Zn, Mn according to the methods described by Cottenie *et al.* (1982).

The dry seeds were then ground to fin powder and analyzed for the determination of total carbohydrates according to the modified Shaffer and Hartman (1921). N content was estimated and protein percentage was calculated according to A.O.A.C. (1975).

The data was statistically analyzed according to Snedecor and Cochran (1967). L.S.D. at 5 % level of significance was used to compare between means.

RESULTS AND DISCUSSION

1. The effect of Pendimethalin and IAA on associated weeds :

The effect of Pendimethalin and IAA on fresh and dry weights of associated weeds per square meter were assessed at 50 and 75 days from sowing.

The major weeds species which were found in the cowpea field were annual broad leaved weeds i.e. *Chenopodium ambriosaides, Portulaca oleraceae* and *Brassica tournofortion Grasses*, also found *Dactyloctenium aegyptium* and *Cynodon dactylon.*

Data presented in Tables (2 and 3) clearly indicated that the treatments were varied in their effects on fresh and dry weights of associated weeds recorded at 50 and 75 days old.

Table (2) : Effect of Pendimethalin treatment and IAA on associated weeds of cowpea plant after 50 days from sowing. (Combined analysis for two seasons).

Treatment	Broad leaved (Fresh wt.)	Grasses (Fresh wt.)	Total (Fresh wt.)	Broad leaved (Dry wt.)	Grasses (Dry wt.)	Total (Dry wt.)
Unweeded control	94.7	41.0	135.7	23.2	13.9	37.1
IAA 12.5 ppm	89.0	39.0	128.6	21.2	13.1	34.3
IAA 25 ppm	87.6	36.7	124.3	20.6	12.5	33.1
IAA 50 ppm	89.1	37.7	127.0	22.2	13.9	36.1
0.9 Pendimethalin	45.0	19.0	64.0	16.3	5.2	21.5
0.9 + 12.5 ppm	38.0	16.7	54.7	13.2	5.3	18.7
0.9 + 25 ppm	38.0	16.2	54.2	11.3	4.9	16.1
0.9 + 50 ppm	39.0	17.0	56.0	13.3	5.6	18.9
1.7 Pendimethalin	36.4	13.6	50.0	10.9	3.6	14.5
1.7 + 12.5 ppm	36.4	13.7	50.1	9.6	3.2	12.5
1.7 + 25 ppm	35.6	12.0	47.6	9.0	3.0	12.0
1.7 + 50 ppm	36.8	13.5	50.3	9.3	3.2	12.5
L.S.D. 5 %	7.4	5.0	15.7	5.2	2.08	6.5

Table (3) : Effect of Pendimethalin treatment and IAA on associated weeds of cowpea plants after 75 days from sowing (Combined analysis for two seasons).

Treatment	Broad leaved (Fresh wt.)	Grasses (Fresh wt.)	Total (Fresh wt.)	Broad leaved (Dry wt.)	Grasses (Dry wt.)	Total (Dry wt.)
Unweeded control	303.0	63.2	366.2	93.5	18.2	111.7
IAA 12.5 ppm	294.0	59.5	353.5	92.2	17.3	109.5
IAA 25 ppm	290.0	57.0	347.0	90.0	17.0	107.0
IAA 50 ppm	292.0	61.0	353.0	91.0	17.6	108.6
0.9 Pendimethalin	146.0	36.2	182.2	39.9	10.1	50.0
0.9 + 12.5 ppm	145.0	35.0	180.0	38.2	9.2	47.4
0.9 + 25 ppm	138.0	34.0	172.0	33.2	8.5	41.7
0.9 + 50 ppm	139.0	36.0	175.0	38.0	10.0	48.0
1.7 Pendimethalin	120.0	25.5	145.5	35.0	7.0	42.0
1.7 + 12.5 ppm	115.0	23.1	138.1	33.0	6.7	39.7
1.7 + 25 ppm	110.0	20.0	130.0	29.6	5.6	35.2
1.7 + 50 ppm	116.0	26.0	142.0	33.0	6.5	39.5
L.S.D. 5 %	16.18	8.00	22.12	4.3	3.3	13.98

Pendimethalin at the two rates 0.9 L/fed. and 1.7 L/fed. alone or combined with IAA significantly depressed the growth of the associated weeds. The maximum weeds control was obtained from Pendimethalin at rate of 1.7 L/fed. combined with IAA (25 ppm) followed by Pendimethalin at the rate of 0.9 L/fed. + IAA (25 ppm).

These decreases may be due to the increase in vegetative growth of the plants treated with the Pendimethalin + IAA which caused inhibition in the growth of weeds.

The superiority of Pendimethalin herbicide in controlling cowpea weeds could be attributed to its higher effect against broad leaved. On the other hand, efficiency of Pendimethalin was more evident after 75 than 50 days from sowing. This may be due to the high temperature during this period (June – July). Similar findings were obtained by Moursi *et al.* (1979) who

reported that high temperature increased toxicity effect of Pendimethalin in the rice field in relation to herbicide effect.

IAA treatments alone were the least effective during all growth stages whereas combined application of IAA with Pendimethalin gave significant decrease of total fresh and dry weight of weeds.

These results coincide with these of El-Quesni *et al.* (1993) who stated that Pendimethalin gave excellent control of cowpea weeds. Rathore, *et al.* (2003) showed that Pendimethalin at 1.0 kg/ha. was highest weed control efficiency on dew bean.

2. Effect of Pendimethalin and IAA treatments on vegetative growth and yield of cowpea :

Plant growth and yield characters were affected by application of Pendimethalin alone or in combination with IAA when compared with untreated plants as shown in Table (4).

Table (4) : Effect of Pendimethalin treatment and IAA on vegetative growth and yield of cowpea plant (combined analysis for two seasons).

Treatment	Plant height (cm)	No. of plant			Dry wt. of shoots gm/plant	Seed index wt. of 100 seeds	Total yield gm/plant	Total yield kg/fed.
		Leaves	Branches	Pods				
Control	50.0	39.0	5.2	17.6	39.2	17.2	34.4	850
IAA 12.5 ppm	59.2	44.0	6.0	20.0	42.7	19.8	40.0	890
IAA 25 ppm	63.4	49.5	7.5	20.5	45.5	21.4	42.8	950
IAA 50 ppm	58.6	41.2	5.6	17.8	40.0	18.0	36.0	860
0.9 Pendimethalin	53.5	42.7	6.7	18.2	42.0	19.2	37.1	920
0.9 + 12.5 ppm	62.3	46.0	7.2	18.9	45.9	21.5	45.5	970
0.9 + 25 ppm	69.0	48.3	8.2	19.5	49.0	22.3	49.7	1021
0.9 + 50 ppm	56.7	41.9	6.8	18.3	43.2	20.1	41.2	956
1.7 Pendimethalin	56.3	44.0	7.1	19.0	46.0	20.5	41.2	10.20
1.7 + 12.5 ppm	70.3	48.3	8.0	20.0	50.0	22.0	49.2	1150
1.7 + 25 ppm	75.9	50.5	9.3	22.6	55.2	23.0	52.0	1220
1.7 + 50 ppm	58.0	42.4	6.6	19.2	47.1	20.9	42.0	1095
L.S.D. 5 %	2.6	1.5	0.62	0.51	2.30	1.18	7.58	29.8

The results in Table (4) indicate that there are significant increases in plant height, No. of leaves, branches and pods per plant, dry weight of plant, total yield per plant, total yield per fed. and seed index by increasing Pendimethalin rate/fed. The increase in growth and yield characters by using Pendimethalin may be due to prevent the competition between weeds and cowpea plants for nutrients and water and consequently the growth of cowpea was enhanced. Previous investigators came to similar results (Egunjabi and Adegake, 1990), El-Maziny and El-Sayed (1991), Dubey *et al.* 1991, Kumar and Kairaw, 1991 and El-Quesni, *et al.*, 1993). They observed increase in plant height, number of leaves and pods and yield by treating cowpea with Pendimethalin. Recently Ramakrishna (2003) reported that Pendimethalin as pre-emergence (1.0 kg/fed.) increased yield of cowpea plant.

The IAA treatment results indicate that there are significant increase in No. of leaves, branches and pods, plant height, seed yield/plant and seed yield/fed. by increasing IAA concentration up to 25 ppm, whereas they

decrease under highest concentration (50 ppm) but still higher than the control. These results are in agreement with the result obtained by Bhargawa and Chandra, (1989), who reported that low concentration of IAA increased growth and yield of cowpea plants while high concentration of IAA decrease the growth and yield.

The increase in growth and yield characters by using IAA treatments usually reported to be due to the increase in length of internodes and stimulating the cell division of plant and consequently the dry weight of plants and seed yield increased.

Darra *et al.* (1973) supports the hypothesis that the beneficial effects of hormones may increase water absorption. Klerk *et al.* (2000) and Fratini and Ruiz (2003) reported that IAA was the best auxin for the induction highest rooting percentage followed by increasing of water absorption.

The same results were obtained by Bhargawa and Chandra (1989) Ogbonna and Abraham (1989) Khalil and Mandurah (1989) and Biswas *et al.* (2000).

Table (3) shows that the Pendimethalin (1.7 L/fed.) combined with IAA (25 ppm) gave the tallest cowpea plants and produced the highest number of plant branches, leaves and pods and seed yield. Whereas the control plants gave the lowest number and yield seed as compared with other treatments.

The aforementioned results indicate that Pendimethalin combined with IAA treatments favours the growth of cowpea and the superiority of these treatments is correlated with their markedly efficient on cowpea associated weeds. This finding could be due to the limiting weed infestation and minimizing weed competition which, in turn, favours growth of cowpea plants.

The harvest index increased by application with Pendimethalin and IAA when compared with the control. This ratio is a good indicator of the effectiveness of the treatments used for seed production.

The increase in No. of pods, No. of branches per plant and total yield of seeds/plant as well as seed index by Pendimethalin and IAA treatments led to good seed yield per fed.

3. Chemical composition of seeds :

The effect of chemical weed control and IAA treatments on chemical composition of cowpea seeds are presented in Table (5). The results reported in Table (5) revealed that weed control (Pendimethalin) and IAA treatments increased N, P, K, Zn and Mn content of cowpea seeds. These increases in N, P, K, Mn and Zn my be due partly to the follows :

1. The beneficial effects of Pendimethalin was decreasing the dry weight of associated weeds which compete with cowpea roots for available mineral nutrients.
2. Pendimethalin treatment increased the Zn and Mn contents as compared with control. These results may be attributed to the positive correlation between N and both Zn and Mn by plants. It is reported that Zn is closely involved in the N-metabolism (Price *et al.*, 1972).

3. The positive effect of IAA may be attributed to its effect on the rate of *cations and anion uptake by roots system of plants (Shaddad et al.* (1989) reported that IAA effects uptake translocation and accumulation of certain macroelements in plants organs.

Table (5) : Effect of Pendimethalin treatment and IAA on chemical content of cowpea seeds. (Combined analysis for two seasons).

Treatment	mg/g			ppm		Carbohydrate %	Protein %
	N	P	K	Mn	Zn		
0	3.31	0.31	1.05	6.60	44.8	41.44	24.96
IAA 12.5 ppm	3.92	0.35	1.05	10.50	51.0	45.92	26.78
IAA 25 ppm	4.13	0.37	1.25	10.90	52.0	47.52	28.08
IAA 50 ppm	3.56	0.32	1.05	6.60	48.0	48.30	27.82
0.9 Pendimethalin	3.81	0.33	1.00	12.50	52.0	46.90	25.60
0.9 + 12.5 ppm	4.01	0.36	1.20	12.50	56.0	47.00	26.26
0.9 + 25 ppm	4.43	0.39	1.12	16.00	58.0	49.50	29.56
0.9 + 50 ppm	3.98	0.35	1.07	10.50	54.0	47.80	26.26
1.7 Pendimethalin	4.10	0.34	1.15	10.50	52.0	47.96	27.56
1.7 + 12.5 ppm	4.31	0.38	1.25	12.50	56.0	48.44	28.90
1.7 + 25 ppm	4.98	0.46	1.25	16.60	77.0	50.20	29.64
1.7 + 50 ppm	4.47	0.38	1.10	10.50	52.0	49.20	26.80

The highest values of N, P, K, Zn and Mn were obtained by Pendimethalin (1.7 L/fed. + IAA (25 ppm).

Similar results of Pendimethalin effect on mineral nutrients content of cowpea seeds were obtained by El-Quesni *et al.* (1993), Ramakrishna (2003) and Rathore *et al.* (2003).

The effect of IAA treatments on mineral nutrients content of cowpea seeds were also reported by Abdel-Rahman and Abdel-Hadi (1984), Khalil and Mandurah, (1989), Hathout *et al.* (1993) and Levai *et al.* (2001).

Table (5) show that Pendimethalin as well as the IAA induced increase in total carbohydrate and protein percentage of cowpea seeds. The highest protein percentage was recorded by the combined treatment IAA (25 ppm) Plus Pendimethalin (1.7 L./fed.). The benefinicial effect of Pendimethalin on the associated weeds which compete with cowpea roots for available nitrogen and micronutrient uptake by cowpea roots may be due to the increase in protein percentage. Pendimethalin and IAA treatments increased in Zn and Mn content compared with the control. These results may be attributed to the positive correlation between N and Zn and Mn. It is reported that Zn is closely involved in the N-metabolism, Price *et al.* (1972) who reported that Zn deficiency caused a sharp decrease in level of RNA and ribosome contents of cells, this reduction leads to an inhibition of protein formation. Sencer (1978) found that micronutrient increased the mobilization of protein stored in leave and stem and also promoted the translocation of the nitrogenous degradation compounds towards the wheat grain. The positive effect of IAA in increasing protein % may be attributed to its effect on the rate of N, P, K, Mn and Zn uptake by root system of cowpea plants.

The increase in total carbohydrate content by Pendimethalin and the IAA treatments may be attributed to the result that increase in chlorophyll content by using herbicides and hormones and consequently photosynthesis increased. The results obtained by Dodge (1983) who stated that the action of many herbicides is due to promotion of chloroplast electron flow generate free radicals as shown by some diphynil ether. Also, increase in Mn and Zn content by Pendimethalin and IAA may be led to increase in photosynthesis (Koriesh and Helmy, (1984), found that spraying with Zn gave the highest values of chlorophyll a and b. According to Bishop (1971). Mn is essential in photosystem II where it participates in photoslysis.

Similar results were obtained by Khalil and Mandurah (1989) and Kord and Imam (1990).

The present study points to the importance and usefulness of Pendimethalin and low concentration of IAA (25 ppm) application in the newly reclaimed area in order to reduce growth of weeds and increase in seed yield. It may be concluded also that Pendimethalin 1.7 L/fed. + IAA (25 ppm) was the best treatment that increased cowpea seed yield.

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تأثير الرش بمبيد الحشائش بنديميثالين واندول حمض الخليك على الحشائش المصاحبة ونمو ومحصول والمحتوى الكيميائى لنبات اللوبيا

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قسم النبات – المركز القومى للبحوث – الدقى – القاهرة

اجريت تجربتان حقليتان فى موسمين متتالين ١٩٩٨ ، ١٩٩٩ بمنطقة النوبارية (مشروع البساتين) لدراسة تأثير بنديمثيلين (استومب) بثلاث معدلات صفر، ٠,٩ ، ١,٧ لتر/للفدان ودراسة ايضا تأثير اندول حمض الخليك بتركيزات صفر ، ١٢,٥ ، ٢٥ ، ٥٠ جزء فى المليون معا على نمو ومحصول والمحتوى الكيماوى لنبات اللوبيا والحشائش المصاحبة وكانت النتائج كالاتى :

١- ادى الرش بمبيد الحشائش بنديمثيلين سواء بمفردة او مع اندول حمض الخليك نقصا معنويا فى نموالحشائش المصاحبة لنبات اللوبيا اذا قورنت بمعاملة المقارنة وقد لوحظت ان معاملة البنديمثيلين ١,٧ لتر/للفدان + اندول حمض الخليك (٢٥ جزء فى المليون كانت اكثر المعاملات فاعلية فى انقاص الوزن الطازج والجاف للحشائش الكلية بعد ٥٠ ، ٧٥ يوم من الزراعة يليها فى ذلك معاملة بنديميلين ٠,٩ لتر/للفدان + اندول حمض الخليك (٢٥ جزء فى المليون) وعلى العكس من ذلك لم تحدث المعاملات باندول حمض الخليك بمفردها تأثير ملحوظ على الحشائش .

٢- وجد ان الرش بمبيد الحشائش بنديمثيلين واندول حمض الخليك كل على حدة او معا لهم تاثير معنويا بالزيادة على طول النبات وعدد الاوراق والافرع والقرون والوزن الجاف للنبات ومحصول البذور/للفدان ووزن ١٠٠ بذرة عند مقارنتها بالكنترول .

٣-كذلك المحتوى الكيماوى لبذور اللوبيا من البروتين والكربوهيدرات والنتروجين والفوسفور والبوتاسيوم والزنك والمنجنيز قد زادت نتيجة لكل المعاملات المستخدمة بينما كانت الافضلية لمعاملة لبنديمثيلين بمعدل ١,٧ لتر/للفدان +اندول حمض الخليك تركيز ٢٥ جزء فى المليون عند مقارنتها بمعاملة المقارنة .