Bangladesh J. Bot. **42**(1): 99-104, 2013 (June)

EFFECTS OF PLANT EXTRACTS ON GROWTH, YIELD AND PROTEIN CONTENT OF COWPEA (*VIGNA UNGUICULATA* (L.) WALP.)

GAMAL MA LASHIN*, ADEL A AZAB, AKRAM A HUSSIEN AND AM EL-ANWAR[1]

Department of Botany, Faculty of Science, Zagazig University, Zagazig, Egypt

Key words: Plant extracts, Cowpea, Growth, Yield, Protein content

Abstract

Aqueous plant extracts of *Malva parviflora* L. and *Artemisia ludia* L. were tested in the field on cowpea (*Vigna unguiculata* (L.) Walp.) plants. The extracts were added alone and in combination. The treatments were applied just one day before irrigation. Data obtained revealed that the growth, yield and protein content of cowpea were stimulated by 10% aqueous extract of *M. parviflora* and the mixture of 10% *Malva* with 20% *Artemisia.* The data also showed that the soil fertility was improved.

Introduction

During the last two decades, there was a tremendous improvement in soil fertility management (Singh *et al.* 1997). Amendment of soils were done with plant residue to improve nutrient content, physical properties, biological activity and crop performance (Rachie 1985, Singh *et al.* 1997, Karlen *et al.* 1992, Woomer and Swift 1994, Santos 2000, Ferreira 2004, Muhammad *et al.* 2007a,b and Lemma *et al.* 2009). In sub-Saharan Africa there are huge areas of lands suffering from reduction of organic matters (Boyer and Groffman 1996). Hence, incorporation of plant residues in soil management represents an important factor for maintenance soil properties and organic matter (Singh and Rachie 1985). The cowpea plant (*Vigna unguiculata* (L.) Walp.) is a seed legume that plays an important role in world-wide cultivation (Ehlers and Hall 1997, Santos 2000). The plant is an annual bushy herb plant with erect stem but, depending on varieties, stem may be, creeping or climbing (Sivak and Walker 1986, Ferreira 2004 and Shao *et al.* 2008). It is an important economic crop in many developing regions due to its high protein content, adaptability to different types of soil and intercropping systems. The crop is also suitable due to its resistance to drought, its ability to improve soil fertility and prevent erosion of the soil (Franklin and Riley 1977, Hulugalle *et al.* 1986, Shao *et al.* 2008).

The aim of this work is to investigate the effects of aqueous extract of *Artemisia ludia* L. and *Malva parviflora* L. on growth, yield and protein content of cowpea and soil fertility.

Materials and Methods

The cowpea seeds (*Vigna unguiculata)* were obtained from Agricultural Research center, Dokky, Giza, Egypt. Two aqueous extracts of *M. parviflora* and *A. ludia* (Table 1) were used in three concentrations of each namely, 5, 10 and 20% (w/v) either singly or mixed together at their possible combination to obtain 15 treatments in addition to a control. The treatments are M20, M10, M5, A20, A10, A5, M20 + A20, M20 + A10, M20 + A5, M10 + A20, M10 + A10, M10 + A5, M5 + A20, M5 + A10, M5 + A5 where 'M' and 'A' indicate the extracts of *Malva* and *Artemisia*, respectively and the attached number indicate their percentages. Each treatment was replicated thrice. At pre-planting, 75 ml of each concentration were injected in soil around the seeds just one day before irrigation under field conditions in land of Zagazig City, Sharkyia Governorate, Egypt during summer season of 2008 - 2010. Finally one plant was kept per

*Author for correspondence: <gamalsabaa@yahoo.com>, [1]El-Ahrar Hospital, Zagazig, Egypt.

quadrate. Soil analysis was carried out before and after germination of seeds at two different depths (0 - 12 cm and 12 - 25 cm). Growth parameters were measured. The plant shoot with highest and the lowest treatments beside control were analyzed for the nitrogen content. The effect of each treatment was tested on germination of cowpea plants under laboratory conditions till 10 days.

Table 1. Phytochemical screening of *Malva parviflora* and *Artemisia ludia.**

M. parviflora		*A. ludia*	
Compounds	Levels	Compounds	Levels
Carbohydrate and glycosides	+ + +	Cyc ohexanone 5-melthyl (2-methlethyl)	+
Triterpenes and steroids	+ + +	Isopropyl-5-methylex-2-enal	+
Sesquiterpene lactones	+	4-isopropyl-1,3 – cyclohexanediene	+
Flavenoids	+ +	Pyrimidine, 6-oxo-5-actyle-4-hydroxyl-1, 6 dihdro	+ +
Alkaloids or nitrogenous basic compounds	+	Cyclohexanone, 5-methyl-2-(Imethyl)-, (2s-cis)	+ + +
Volatile oils	+ +	Heptadecane, 2,6,10,14, tetramethyl	+ +
Coumarin	+	Decane, 2- methyl	+
		Benzene, (1,3,3 trmethyl nonyl)	+ + +

*Harborne (2007), Aiyegoro and Okoh (2010). (+++ = rich, + + = medium, + = rare).

Table 2. Physical and chemical properties of soil samples before plantation of cowpea.

Soil parameters	Depth (cm)	
	0 - 12	12 - 25
Moisture %	10.8	18.1
Nitrogen %	0.09	0.075
Organic matter %	1.31	1.27
Calcium carbonate %	3.20	2.25
Total soluble salts	0.084	0.100
Available		
N (ppm)	25.00	20.00
P (ppm)	15.6	7.2
K (ppm)	463	338
pH	7.7	7.8

The collected soil samples from 0 - 12 and 12 - 25 cm depths of the field were analyzed after Cottenie *et al.* (1982) (Table 3). Exchangeable bases (K-Na-Mg and Ca) were analyzed using neutral ammonium acetate after drying and passing the sample through 2 mm sieve. Organic matter, electrical conductivity (EC) and soluble salts (carbonates, bicarbonates, sulphates and chlorides) were also determined by standard methods. All chemical analysis were carried out at National Research Center (Land Resources Evaluation and Mapping Unit), Dokki, Giza, Egypt.

Plant lengths, branch length, number of branches, leaf, flowers (inflorescences) and fruits together with leaf area were measured and counted. Three treatments were chosen to determine protein and nitrogen content for control, optimum and suboptimum plant growth (Lowery *et al.* 1951, Said and El-Shishiny 1944). All data obtained were subjected to analysis of variance

(ANOVA) as described by Cottenie *et al.* (1982), while separation of means was done according to Duncan (1958).

Results and Discussion

Effects of M. parviflora and A. ludia on soil properties: Table 2 shows slight increase in alkalinity with increasing depth. Table 3 reveals that there is a slight increase in K^+ with both the extracts i.e., 20% for each with increasing *Malva* and *Artemisia* extracts. In relation to Na^+, no significant change appeared. Mg^+ showed a significant increase at 20% *Artemisia* extract alone while Ca^+ content increased at 10% *Malva* residue than any other t reatments. On the other hand,

Table 3. Chemical properties of soil after harvesting cowpea.

Treat-ment levels (%)	%		Soluble ions (mg/l)					Alternative ions (mg/100 g soil)			
	OM	$CaCO_3$	EC (5:1)	CO_3^-	HCO_3^-	Cl^-	SO_4^-	Ca^{++}	Mg^{++}	Na^+	K^+
M20	2.32	2.5	0.50	0.56	2.24	1.6	1.04	40.0	12.8	4.4	1.16
	(2.43)	(2.90)	(0.83)	(0.56)	(1.82)	(3.40)	(1.69)	(38.0)	(6.00)	(5.6)	(0.69)
M10	2.27	3.6	0.64	0.28	2.52	1.8	1.44	52.0	8.0	5.2	1.27
	(1.96)	(3.80)	(0.43)	(0.28)	(2.32)	(1.00)	(0.77)	(32.2)	(13.2)	(4.5)	(0.81)
M5	2.01	3.6	0.49	0.64	1.66	1.8	1.02	41.2	12.0	5.1	1.35
	(1.96)	(3.80)	(0.59)	(0.56)	(2.24)	(2.00)	(1.27)	(31.2)	(11.2)	(5.3)	(0.87)
A20	1.99	2.7	0.45	0.42	1.96	1.4	0.93	36.0	17.2	4.8	0.93
	(0.31)	(1.70)	(0.84)	(0.24)	(1.43)	(3.20)	(2.92)	(25.2)	(4.8)	(4.9)	(0.20)
A10	2.06	3.3	0.56	0.56	1.68	1.6	1.30	32.0	11.2	5.4	0.93
	(2.96)	(3.60)	(0.50)	(0.24)	(1.96)	(1.60)	(0.85)	(35.60)	(14.00)	(4.8)	(0.81)
A5	2.22	4.2	0.49	0.64	1.52	1.6	0.97	30.8	11.2	4.6	0.87
	(2.010)	(4.50)	(0.51)	(0.65)	(1.96)	(1.80)	(1.05)	(38.8)	(12.80)	(5.00)	(0.77)
M20 + A20	2.32	3.8	0.51	0.46	2.0	1.5	1.36	38.0	10.0	4.6	1.17
	(2.37)	(4.50)	(0.51)	(0.64)	(1.68)	(1.40)	(1.38)	(28.60)	(9.60)	(4.5)	(0.88)
M20 + A10	2.27	3.8	0.62	0.70	1.96	1.9	139	38.0	11.2	5.1	0.93
	(1.96)	(3.80)	(0.62)	(0.56)	(1.96)	(1.90)	(1.51)	(33.00)	(11.60)	(4.8)	(0.56)
M20 + A5	2.24	4.2	0.56	0.42	2.52	1.4	1.11	33.4	121.0	4.3	1.07
	(1.96)	(4.00)	(0.55)	(0.56)	(2.03)	(1.60)	(1.0)	(39.00)	(11.6)	(4.6)	(0.73)
M10 + A20	2.37	3.6	0.51	0.56	2.38	1.2	1.08	45.2	13.2	4.6	1.24
	(1.50)	(2.00)	(0.43)	(0.70)	(2.10)	(1.00)	(0.79)	(39.60)	(10.8)	(4.6)	(0.86)
M10 + A10	2.32	3.6	0.59	0.85	2.10	1.6	1.42	44.0	17.2	4.8	1.09
	(1.65)	(4.20)	(0.43)	(1.00)	(1.05)	(1.50)	(1.01)	(43.60)	(11.6)	(5.1)	(0.67)
M10 + A5	1.75	3.3	0.58	1.1	1.26	1.8	1.58	32.0	12.0	4.6	1.01
	(1.50)	(4.50)	(0.68)	(0.84)	(1.68)	(2.20)	(2.03)	(32.80)	(11.20)	(4.60)	(0.50)
M5 + A20	1.78	4.0	0.50	1.12	1.68	1.4	1.10	39.0	13.6	4.6	0.82
	(1.70)	(5.10)	(0.45)	(0.64)	(2.00)	(1.20)	(1.05)	(33.40)	(10.00)	(4.60)	(0.63)
M5 + A10	2.48	4.2	0.58	0.8	1.6	1.8	1.66	37.8	12.4	4.4	1.11
	(1.42)	(4.50)	(0.56)	(0.70)	(2.28)	(1.50)	(1.68)	(35.20)	(14.80)	(4.7)	(0.60)
M5 + A5	1.42	4.0	0.59	1.12	1.68	1.6	1.48	37.4	12.8	4.4	0.83
	(1.50)	(3.80)	(0.48)	(0.70)	(1.60)	(1.30)	(1.24)	(46.00)	(6.8)	(4.6)	(0.63)
Control	2.48	3.8	1.2	1.05	1.93	3.8	5.68	32.4	7.4	7.1	1.34
	(1.42)	(4.00)	(0.49)	(1.00)	(1.20)	(1.60)	(1.43)	(40.00)	(11.60)	(4.8)	(0.74)

M = *Malva parviflora*, A = *Artemisia ludia*.

the anions (SO_4^{-2}, Cl^- and HCO_3^-) slightly increased at 10% *Malva* extract, which explains its importance in neutralization of the soil alkalinity slightly. The CO_3^{-2} content increased at 20% of extract in mixture. $CaCO_3$ content increased at 10% *Malva* and 5% *Artemisia* alone. Electrical conductivity (EC) measured remained unchanged except at 10% *Malva* alone and was less than control. Table 2 also reveals that the plant extracts lead to the same changes in the cations concentration with depth. The Cl^- content decreases than the control in all the treatments while the HCO_3^- tends to change irregularly. The CO_3^{-2} content slightly increased at low rate of mixture while decreased in other treatments as compared with control. The EC and OM content measured was higher in control due to the little decomposition and mineralization.

Growth and morphological measurement: Data of Table 4 reveals that most of the treatments had no significant effect on the plant growth. *Malva* extract at 10% conc. and *Artemisia* extract at 20% conc. together increased the plant height, number of leaves, lateral branches, fruits and flower, together with leaf area. However, the same trend was absent for combination at 5% *Malva* and 20% *Artemisia* extract. On the other hand, each of 5 and 10% *Malva* alone and all single concentrations of *Artemisia* were inhibitors for growth parameters.

Table 4. Morphological characters in cowpea.

Treatment levels (%)	Plant length (cm)	Branch length (cm)	Branch no.	Leaf no.	Leaf area (cm^2)	Fruit no.
M20 (inhibitor)	65.67	17.87	13.00	85.00	60.47	26.0
M10	94.00	25.40	14.00	130.7	66.17	30.0
M5	99.00	22.97	15.67	101.0	61.17	38.0
A20	89.67	21.43	14.67	113.0	59.37	30.0
A10	97.33	23.50	15.00	151.3	70.73	40.0
A5	115.3	18.57	21.67	75.67	53.43	45.0
M20 + A20	98.33	19.87	13.00	78.00	55.17	30.0
M20 + A10	101.7	28.53	16.00	191.0	68.87	35.0
M20 + A5	96.33	34.00	15.67	159.0	71.13	31.0
M10 + A20 (Promoter)	145.3	40.40	15.33	161.3	71.13	32.0
M10 + A10	103.3	29.30	16.00	183.7	65.43	35.0
M10 + A5	104.0	29.30	14.33	109.3	68.03	28.0
M5 + A20	79.67	40.93	15.67	198.0	67.23	30.0
M5 + A10	103.7	33.47	14.67	188.3	74.00	28.0
M5 + A5	122.0	33.27	16.00	108.7	76.37	35.0
Control	109.7	42.00	11.67	187.0	59.40	33.0
LSD (p = 0.05)	3.335	16.22	10.23	6.253	13.60	12.50

M = *Malva parviflora*, A = *Artemisia ludia*.

Organic matter (OM), on the other hand, apparently reveals unchanged condition due to incomplete mineralization of the extracts at the soil surface, (Rachie 1985, Dick *et al.* 1988, Karlen *et al.* 1992). Santos (2000) and Muhammad *et al.* (2007a) concluded the inverse relationship between organic matter content and mineralization. Number of microorganisms at the soil surface decreased the mineralization rate of the residues on one hand and increases the salt absorbance by the extract on the other hand (Muhammad *et al.* 2007b, Lemma *et al.* 2009). While the increase of the EC in the control may be related to the solubility of salts, which may be absorbed in other treatments in their organic matter of extract.

This result suggested that the presence of coumarin in extract of *Malva* and some growth inhibitors in the extract of *Artemisia* suppressed the plant growth individually, while their mixture together counteract the effect of *Artemisia* when applied singly. The availability of nutrient and get red off growth inhibitors in mixture of the extracts slightly prevented the plant growth (Ferreira 2004, Adelusi and Aileme 2006).

Table 5. Nitrogen and protein content of cowpea as influenced by *Malva* and *Artemisia* pre-anthissing.

Treatments (%)	Control	10% *Malva* + 20% *Artemisia* (mg/ml)	20% *Malva* (mg/ml)
Total nitrogen	2.45	3.86	2.86
Total protein	15.31	24.14	17.85

Two treatments were chosen only to evaluate the effects the *Malva* and *Artemisia* extracts on nitrogen content depending on the previous data of their effect on growth. The results in Table 5 showed an increase in each of total and insoluble nitrogen in mixture of the extract while decrease in the same values was obtained on using high concentration of *Artemisia* (Franklin and Riley 1977, Lemma *et al.* 2009).

It was found that ions availability in soil increased due to use of mixtures of both extracts at high levels. Fractionation analysis of each extract shows that *Artemisia* extract include mostly growth inhibitors as observed for growth. While *Malva* extract contain different compound of growth promoters and some growth inhibitors. On the other hand mixing of *Malva* and *Artemisia* extracts could counteract the inhibitory effect of each of them.

References

Adelusi AA and Aileme JD 2006. Effects of light and nutrient stress on some growth parameters of cowpea (*Vigna unguiculata* (L.) Walp). Res. J. Bot. **1**: 95-103.

Aiyegoro OA and Okoh AI 2010. Preliminary pytochemical screening and *in vitro* antioxidant activities of the aqueous extract of *Helichrysum longifolium* DC. BMC Complement Altern. Med. **10**: 21.

Boyer JN and Groffman PM 1996. Bio-availability of water extractable organic carbon fractions in forest and agricultural soils profiles. Soil Biol. Biochem. **28**: 783-790.

Cottenie A, Verloo M, Kiekens L, Velghe G and Camerlynck R 1982. Chemical analysis of plant and soils. Laboratory of Analytical and Agrochemistry, State University of Gent, Belgium. p. 63.

Duncan CG 1958. Studies on the methodology of soil block testing. USAD Forest Serv. Rep. No. **2114**: 1-126.

Dick RP, Rasmussen PE and Kerle EA 1988. Influence of long-term residue management on soil enzyme activity in relation to soil chemical properties of a wheat-fallow system. Biology and Fertility of Soils **6**: 159-164.

Ehlers JD and Hall AE 1997. Cowpea (*Vigna unguiculata* (L.) Walp.). Field Crops Res. **53**: 187-204.

Ferreira FR 2004. Effect of different levels of water deficit on yield of groundnut, cowpea and maize. Thesis, college of Agriculture and Forestry, Maputo. p. 334.

Franklin JP and Riley JB 1977. Optimizing Crop Production through Control of Water and Salinity Levels in the Soil. Utah water Research Laboratory, Logan. p. 66.

Harborne JB 2007. Phytochemical methods: A guide to modern techniques of plant analysis, 3rd edition, Chapman and Hall, London, 125-75.

Hulugalle N, Lal R and Terkuile CHH 1986. Amelioration of soil physical properties by mucuna after mechanized land cleaning of a tropical rain forest. Soil Sci. **141**: 219-224.

Karlen DL, Eash NS and Unger PW 1992. Soil and crop management effects on soil quality indicators. Amer. J. Alt. Agric. **7:** 48-55.

Lemma GW, Worku C and Woldemichael V 2009. Moisture and planting density interactions affect productivity in Cowpea. J. Agron. **8**: 117-123.

Lowery OH, Rosebrough NJ, Farr AL and Randall AS 1951. Protein measurements with the folin phenol reagent. J. Biol. Chem. **193**: 256-257.

Muhammad S, Müller T, Mayer J and Joergensen RG 2007a. Impact of growing maize (*Zea mays*) on the decomposition of incorporated fresh alfalfa residues. Biology Fertility of Soils **43**: 399-407.

Muhammad S, Müller T and Joergensen RG 2007b. Compost and phosphorus amendments for stimulating microorganisms and maize growth in a saline Pakistani soil in comparison with a nonsaline German soil. J. Plant Nutr. and Soil Sci. **170**: 745-751.

Rachie KO 1985. Introduction: Cowpea Research. *In:* Production and Utilization, Singh SR and KO Rachie (Eds). John Wiley and Sons, New York.

Said H and El-Shishiny EDH 1944. The effect of disc thickness on the respiration and the various nitrogen fraction of cut discs of radish root immersed in water and sugar solution. Plant Physiol. **19**: 66-72.

Santos AL 2000. Some biotic and abiotic factors affecting the production of Cowpea (*Vigna unguiculata* (L.) Walp) in Mozambique. Undergraduate Thesis, College of Agriculture and forestry Maputo.

Shao HB, Chud LY, Jaleelc CA and Zhaoe CX 2008. Water deficit stress induces anatomical changes. Comptes Rendus Biologies **331**: 215-225.

Singh DK, Sale PWG and Mckenzie BM 1997. Water relations of white clover (*Trifolium repens* L.) in a drying soil, as a function of phosphorus supply and defoliation frequency. Aust. J. Agricul. Res. **48**: 675-682.

Singh SR and Rachie KO 1985. Cowpea Research, Production and Utilization. John Wiley and Sons, New York. pp. 460.

Sivak DA and Walker MN 1986. Mineral Nutrition in Vegetables. John Whiley, New York. p. 234.

Woomer PL and Swift MJ 1994. The Biological Management of Tropical Soil Fertility. John Wiley and Sons, London. p. 345.

(Manuscript received on 12 December, 2012; revised on 16 March, 2013)