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EFFECT OF ORGANIC AND MINERAL NITROGEN FERTILZER AND DICYANDIAMIDE AS NITRIFICATION INHIBITOR ON VEGETATIVE AND SEED YIELD OF JEW'S MALLOW (*Corchorus olitorus* L.)

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ABSTRACT

The present investigation was carried out at Baramoon Experimental Farm, Dakahlia Governorate, Egypt, during 2004 and 2005 seasons, using the jew's mallow cultivar " Balady", to study the effect of dicyandiamide (DCD) application (0 and 3.2 kg/ fed."4% of the added N dose") and four rates of different nitrogen sources (100% mineral N, 75 % mineral N + 25 % organic N, 50 % mineral N + 50 % organic N, 25 % mineral N + 75 % organic N and 100 % organic N), the amount of added nitrogen was adjusted to a total N supply of 80 kg/ fed., as well as their interaction on growth and fresh yield parameters in the first and second cuts , Chemical composition in leaves, seed yield and its components, and seed quality. The obtained results indicated that DCD led to significant increases in all traits, except NO3 accumulation, which was significantly decreased by DCD application. For N sources, they had significant effects on all studied characters in both seasons, raising organic N with decreasing mineral N led to marked decreases in growth and fresh yield parameters and chemical composition in leaves in both cuts and in both seasons, whereas the highest values of number of pods/ plant, seed weight/ pod, seed yield/ fed., seed index and germination percentage were obtained from the treatment of 50% mineral N + 50% organic N in both seasons. The interaction effect between the experimental factors had significant effects on all studied traits in both seasons. Generally, it could be concluded that, application of nitrogen fertilizer in the form of 75% mineral N + 25% organic N or 50% mineral N + 50% organic N combined with DCD in jew's mallow fields were the most effective treatments for satisfactory improvements in fresh and seed yields with keeping the health and safety of human and environment.

INTRODUCTION

Jew's mallow (*Corchorus olitorus* L.) is a popular leafy vegetable crop in Egypt. It is consumed as a fresh vegetable soup; even through the dried leaves could be used as well. It is a valuable source of vitamin A and C, iron, calcium, folic acid, and dietary fiber (Awadalla *et al.*, 1982 and Chen and Saad, 1981). However, Kheir *et al.* (1991) found that it accumulated significantly more nitrate than spinach, lettuce and rocket. Nitrate itself is not toxic but nitrite resulting from microbiological reduction of nitrate during storage or processing of plant material may have toxic effects (Phillips, 1968). Nitrogen is a critically important nutrient for Jew's mallow production; it is an indispensable factor for increasing the vegetative and seed yield and their quality (Ahmed *et al.*, 2004 and Ray and Majumdar, 1995). In Egypt, in order to obtain high yields, growers apply too much nitrogen fertilizer and this custom results in plant nitrate content becoming even higher. Not only is it harmful to human health, but the side effects of over-fertilization on the environment can not be ignored.

Recently, a great attention has been focused on the use of safe, cheap and simple methods in plants production by supplementing organic fertilizers and nitrification inhibitors in order to reduce plant and soil pollutions with nitrate and also to reduce the use of N mineral fertilizers (Mehana, 1998). However, very little research work on jew's mallow has been conducted.

Agricultural systems that receive high or low organic matter inputs would be expected to differ in soil nitrogen (N) transformation rates and fates of ammonium ($NH4^{+}$) and nitrate ($NO3^{-}$)(Burger and Jackson, 2003).The combination of the organic input and supplementary application of mineral fertilizer N has been found as more attractive management option in order to achieve a resource saving and balanced nutrient supply and a high quality vegetative (Hanafy Ahmed *et al.*,1997) and seed (Akoroda and Akintobi, 1983) yield of jew's mallow.

The use of chicken manure as organic fertilization is increasing in Egypt due to its reputation as a quick-acting fertilizer, and it contribute to plant and soil relationship through its effects on physical and chemical and biological properties of the soil, its effect as a source of essential elements ,its ability to increase the availability of certain nutrients as well as its effect in reducing the leaching out of mineral nutrients (Maynard, 1989; Raveendran *et al.*,1994; Ritter *et al*, 1995; Sharpley and Smith,1995; Bulluck *et al.*, 2002; Cooperband *et al.*, 2002; Nahm, 2003). However, chicken manure can degrade water quality through the leaching of nitrate into drainage and ground water (Liebhardt *et al.*, 1979; Sallade and Sims, 1994).

Ammonium ($NH4^{+}$) added to soils by mineral fertilizers or formed by decomposition of organic N compounds is oxidized to nitrate in the nitrification process carried out by specific bacteria (McLaren and Cameron, 1996). Any management technique that could delay nitrification and thereby reduce nitrate leaching would be desirable. Indeed, losses of nitrogen fertilizer by leaching, denitrification and volatilization represent an important problem from economical and environmental point of view.

Recently, many compounds were known and used as nitrification inhibitors such as dicyandiamide (DCD). Several studies emphasized that treating ammonium fertilizers and chicken manure with nitrification inhibitors helped in delaying nitrification of ammonium based fertilizers. By preventing rapid formation of nitrate in the soil, leaching and denitrification losses of nitrogen are limited, thus increasing the efficiency of fertilizers. Lower concentration of nitrate in soil should result in less nitrate contamination of the ground water as well as reduced emission of nitrous oxide from denitrification. (Sallade and Sims, 1992; Sallade and Sims, 1994; Davies and Williams, 1995; Mehana, 1997; El-Saei, 1998; Puttanna *et al.*,1999; Weiske *et al.*, 2001; Laskshmanan, 2004; Di and Cameron, 2004).

Moreover, dicyandiamide (DCD) not only decreases nitrate leaching and nitrous oxide emissions as reported previously, but also decreases the leaching loss of cation nutrients such as Ca^{2+}, K^{+} and Mg^{2+} (Di and Cameron, 2004).

The objective of this study was to estimate the vegetative and seed yield and quality of jew's mallow fertilized with organic and mineral nitrogen and treated with or without dicyandiamide (DCD).

MATERIALS AND METHODS

Two field experiments were performed at Baramoon Experimental Farm, Dakahlia Governorate during 2004 and 2005 seasons, using the jew's mallow cultivar "Balady" to achieve the study objectives.

Some physical and chemical properties of the experimental soil at the depth of 0-30 cm were determined according to the standard procedures as described by Page (1982) and Klute (1986) (Table 1).

Table 1: Some physical and chemical properties of the experimental soil during 2004 and 2005 seasons.

Properties	Values		Properties	Values	
	2004	2005		2004	2005
Sand (%)	28.1	27.9	pH* values	7.7	7.9
Silt (%)	31.8	31.6	EC (dSm^{-1})	0.8	0.9
Clay (%)	40.1	40.5	Total N (%)	0.11	0.12
Texture class	Clay-loam	Clay-loam	Available P (ppm)	11.3	11.0
$CaCO_3$	3.3	3.5	Exchangeable K (ppm)	308	295
OM (%)	2.4	2.3			

*** pH: (1:2.5 soil extract).**

A split plot in randomized complete blocks design with three replications was used. The main plots were included two dicyandiamide (DCD) levels (0 and 3.2 kg/ fed."4% of the added N dose"). The sub plots were assigned to the following four rates of nitrogen sources (the amount of added fertilizer was adjusted to a total N supply of 80 kg/ fed. for jew's mallow production):

1- 100% mineral N (80 kg mineral N/ fed.).
2- 75% mineral N + 25% organic N (60 kg mineral N + 20 kg organic N/fed.).
3- 50% mineral N + 50% organic N (40 kg mineral N + 40 kg organic N/fed.).
4- 25% mineral N + 75% organic N (20 kg mineral N + 60 kg organic N/fed.).
5- 100 % organic N (80 kg organic N/fed.).

The plot consisted of six ridges with a length of 3 m and 60 cm between ridges. Plants were seeded on three rows on the top of each ridge by 10 cm within row.

Seeds were sown on 7 and 4 May in both seasons, respectively. Organic nitrogen as chicken manure was applied before sowing in furrow and raked lightly with soil. The chemical analysis of the used chicken manure was determined by using standard methods described by AOAC (1990) (Table 2). Amounts of chicken manure were calculated based on nitrogen percentage in chicken manure (Table 2) and amount of added organic N.

Mineral nitrogen in the form of ammonium sulfate (20.6% N) at the previously mentioned rates, phosphorus in the form of calcium superphosphate (15.5% P_2O_5) at a rate of 30 kg P_2O_5/ fed., potassium in the form of potassium sulfate (48% K_2O) at a rate of 40 kg K_2O/fed., and DCD were applied at two equal doses, one was added after three weeks from sowing and the other after the first cutting. The normal agricultural practices were followed until harvest.

Table 2: Some properties of chicken manure used in 2004 and 2005 seasons.

Properties	Values		Properties	Values	
	2004	2005		2004	2005
N (%)	2.11	2.04	Fe (ppm)	1370	1340
P (%)	1.78	1.73	Mn (ppm)	184	196
K (%)	2.20	2.10	Zn (ppm)	131	139
OM (%)	48.7	47.5	Cu (ppm)	57	59
C / N	13.7	13.3	EC (dSm^{-1})	0.8	0.9
pH	7.9	8.2			

At the first cut time (after 50 days from planting) and at the second cut time (after 30 days from the first cut), a random sample of ten plants was taken from each plot to estimate the following characters:

1- Foliage fresh weight/ plant. 2- Foliage dry weight/ plant.

3- Leaves weight/ plant. 4- Plant height.

5- N, P, K and NO_3 accumulation in leaves, which was estimated based on leaves dry weight and element percentage in leaves. Total nitrogen was determined with micro-kjeldahl method according to Chapman and Pratt (1961). Phosphorus was colorimetrically determined following Jackson (1973). Potassium was determined using a flame photometer as described by Jackson (1973). NO^-_3 was extracted using 2% acetic acid and determined according to Singh (1988).

6- Protein percentage; was calculated using multiplying N percentage by the conversion factor 6.25.

In addition, in the 1 first cut, each plot (10.8 m^2)was harvested and fresh yield/ fed. was calculated. In the second cut, it was determined from an area of 5.4 m^2, the remainder plants were left for seed production.

At the seed harvest stage, samples of ten plants were taken at random from each plot and the following characters were measured:

1- Number of branches/ plant. 2- Number of pod/ plant. 3- Seed weight/ pod.

4- Seed quality characteristics expressed on weight of 1000 seeds (seed index), germination percentage and rate (fifty seeds were selected at random from each treatment and were germinated on two layers of Whatman No. 1 filter paper in 15 cm Petri dishes, the seed was considered germinated when the shoot attained a length of 5 mm).

In addition, each plot (5.4 m^2) was harvested and determined then seed yield/fed. was calculated.

Data obtained were subjected to statistical analysis by the technique of analysis of variance (ANOVA) for split plot design according to Snedecor and Cochran (1982). The treatments means were compared using Duncan's Multiple Range Test at 5% level of probability as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1- Effect of dicyandiamide (DCD) application:

1.1-Growth and fresh yield parameters:

Data recorded in Table 3 indicate that, adding DCD had significant effects on foliage fresh weight/ plant, foliage dry weight/ plant, leaves weight/ plant, plant height and fresh yield/ fed. in both cuts and in both seasons of study.

Table 3: Effect of dicyandiamide (DCD) application on growth and fresh yield parameters of jew's mallow in the first and second cuts during 2004 and 2005 seasons.

DCD (kg/fed.)	Foliage fresh weight (g/plant)		Foliage dry weight (g/plant)		Leaves weight (g/plant)		Plant height (cm)		Fresh yield (kg/fed)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
First cut										
0	4.8 b	5.1 b	1.17 b	1.22 b	2.2 b	2.3 b	33 b	34 b	885 b	904 b
3.2	5.5 a	5.6 a	1.30 a	1.34 a	2.4 a	2.6 a	37 a	38 a	1001 a	1017 a
Second cut										
0	9.1 b	9.9 b	2.12 b	2.30 b	4.4 b	4.9 b	38 b	39 b	1684 b	1826 b
3.2	10.7 a	11.7 a	2.48 a	2.72 a	5.3 a	5.7 a	41 a	42 a	1967 a	2131 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

These pronounced positive effect on the growth and fresh yield parameters of jew's mallow plants may be attributed to decreasing N-losses and increasing the N-use efficiency with DCD addition ,and consequently, increase the plant chance to absorb nitrogen and other elements (Table 4), thereby, produce good growth, especially where soils are poor in nitrogen and organic matter as this study situation (Table 1).

1.2- Chemical composition:

Data presented in Table 4 show that, the differences in means of N, P and K accumulation due to DCD addition were significantly increased. In contrast, NO_3 accumulation was markedly decreased by DCD addition. These results were true in both cuts and in both seasons.

Table 4: Effect of dicyandiamide (DCD) application on chemical composition of jew's mallow leaves in the first and second cuts during 2004 and 2005 seasons.

DCD (kg/fed.)	N accumulation (mg/plant leaves)		P accumulation (mg/plant leaves)		K accumulation (mg/plant leaves)		NO_3 accumulation (mg/kg dry wt)		Protein (%)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
First cut										
0	1729 b	1725 b	241 b	240 b	2243 b	2260 b	446 a	440 a	17.1 b	16.5 b
3.2	2081 a	2040 a	305 a	298 a	2468 a	2442 a	402 b	396 b	17.8 a	17.1 a
Second cut										
0	2907 b	3156 b	413 b	450 b	3793 b	4330 b	484 a	475 a	15.9 b	15.4 b
3.2	3569 a	3873 a	529 a	576 a	4561 a	4997 a	429 b	422 b	16.5 a	16.0 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

The positive effect of DCD on N, P, and K accumulation may due to the efficiency of DCD in keeping nitrogen for longer time in the form of NH_4^+ which helps in modification of nutrient uptake by plant (Di and Cameron, 2004). Moreover, Tisdale *et al.* (1985) reported that the addition of nitrogen in combination with adequate phosphorus tended to increase K-uptake by plants. They added also that, potassium concentration may be as high in the NH_4^+-nourished plants as it absorbed by soil colloides, so, it does not leach out of soil and still reliable for plants, generally such case may give the plant a more chance for absorbing N, and consequently, the other nutrients for building dry matter.

The negative effect of DCD on NO_3 accumulation may be attributed to the effect of DCD which keeps the N-dose for longer time in the form of NH_4^+, by preventing rapid formation of nitrate in the soil (Sallade and Sims, 1992; Sallade and Sims, 1994; Davies and Williams, 1995; Sema *et al*, 1996; Mehana, 1997; Puttanna *et al.*,1999; Weiske *et al.*, 2001; Laskshmanan, 2004; Di and Cameron, 2004) and in turn increase NH_4 : NO_3 ratio in the soil (Martin et al.,1997), which gives the chance to absorb more NH_4-N, which might be diminished NO_3 accumulation in plant(Header *et al.*, 1997 and El-Saei, 1998).

In regard to the pronounced positive effect on protein content due to DCD addition, this may be attributed to the role of DCD in increasing NH_4^+: NO_3^- ratio in the soil, which lead to increase the uptake of nitrogen by plant (Table 4), and consequently, the biosynthesis of protein.

1.3- Seed yield and its components:

Results of Table 5 show that number of branches/ plant, number of pods/ plant, seeds weight/ pod and seed yield/ fed. of jew's mallow plants treated with DCD were significantly increased than those without DCD. These results were true in both seasons.

The increases in these traits may be due to the superiority of vegetative growth parameters (Table 3) and N,P, and K accumulation (Table 4) of the same treatment, in turn, enhanced the whole metabolic activities, those might be extended positively to yield components of seeds.

Table 5: Effect of dicyandiamide(DCD) application on seed yield of jew's mallow and its components during 2004 and 2005 seasons.

DCD (kg/fed.)	No. branches / plant		No. pods / plant		Seed weight / pod (g)		Seed yield (kg/fed.)	
	2004	2005	2004	2005	2004	2005	2004	2005
0	3.0 b	3.2 b	10.6 b	11.6 b	0.39 b	0.41 b	882 b	924 b
3.2	3.3 a	3.5 a	12.4 a	13.2 a	0.42 a	0.43 a	1018 a	1104 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

1.4- Seed quality:

There were significant effects for DCD application on seed index, while germination percentage and germination rate were not significantly affected in both seasons. More specific, adding DCD to soil had a significant positive effect on seed index in both seasons (Table 6).

This result reflects the nutritional status of plants as a result of increase NH_4^+: NO_3^- ratio in the soil, which caused good seed development and heavier weight of seeds.

Table 6: Effect of dicyandiamide (DCD) application on jew's mallow seed quality during 2004 and 2005 seasons.

DCD (kg/fed.)	Seed index		Germination %		Germination rate (day)	
	2004	2005	2004	2005	2004	2005
0	1.49 b	1.51b	93 a	94 a	2.8 a	2.8 a
3.2	1.52 a	1.54 a	95 a	95 a	2.7 a	2.6 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

2- Effect of rates of nitrogen sources:

1.2-2.1- Growth and fresh yield parameters:

From Table 7, it is clear that, foliage fresh weight/ plant, foliage dry weight/ plant, leaves weight/ plant, plant height and fresh yield/ fed. were significantly influenced by different rates of nitrogen sources. Raising organic nitrogen (chicken manure) with decreasing mineral nitrogen led to marked decreases in studied traits. These results were true in both cuts and in both seasons of study.

Table 7: Effect of rates of nitrogen sources (mineral "M" and organic "O") on growth and fresh yield parameters of jew's mallow in the first and second cuts during 2004 and 2005 seasons.

Nitrogen sources	Foliage fresh weight (g/plant)		Foliage dry weight (g/plant)		Leaves weight (g/plant)		Plant height (cm)		Fresh yield (kg/fed)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
					First cut					
100% M	6.3 a	6.6 a	1.48 a	1.53 a	2.7 a	2.8 a	41.2 a	44.1 a	1150 a	1195 a
75%M+25%O	5.7 b	5.9 b	1.35 bc	1.42 a	2.6 ab	2.7 a	39.2 b	39.0 b	1050 b	1076 b
50%M+50%O	5.2 c	5.3 c	1.24 c	1.26 b	2.4 bc	2.4 b	35.2 c	35.8 c	964 c	968 c
25%M+75%O	4.6 d	4.7 d	1.11 d	1.14 bc	2.1c	2.2 bc	30.9 c	31.3 d	823 d	821 d
100%O	4.2 d	4.3 d	1.02 d	1.05 c	1.8 d	2.0 c	29.0 c	29.9 d	731 e	743 e
					Second cut					
100% M	12.8 a	13.9 a	2.75 a	3.14 a	5.9 a	6.8 a	45.6 a	46.3 a	2288 a	2492 a
75%M+25%O	11.5 b	12.5 b	2.59 ab	2.87 b	5.5 b	6.1 ab	42.8 ab	44.0 ab	2109 b	2290 b
50%M+50%O	10.6 c	11.6 b	2.47 b	2.66 b	5.2 b	5.7 b	41.0 b	41.5 b	1966 c	2128 c
25%M+75%O	8.1 d	8.8 c	1.97 c	2.08 c	4.1 c	4.3 c	35.3 c	35.6 c	1500 d	1623 d
100%O	6.7 e	7.4 d	1.74 c	1.82 d	3.6 d	3.6 d	32.2 d	32.6 c	1266 e	1361 e

Means followed by a common letter in the same column and in the same cut do not differ significantly by Duncan's Multiple Range Test, 5% level

These results may be due to the fact that, nutrients in mineral fertilizers were directly available to plant roots, while the nutrients of organic manures especially organic N were release and available with time. Moreover, these results coincide with those obtained by Jakse and Mihelic (1999), who found that cabbage and spinach plants grown under mineral fertilizers were higher, heavier and larger than organically grown plants. Moreover, Gani *et al.* (2001) found that the greatest improvement in the growth and yield of jew's mallow was obtained with Poultry manure at 0.5 t/ha and 90 kg N /ha.

2.2- Chemical composition:

It is evident from the data in Table 8 that, the effect of different rates of nitrogen sources on N, P, K and NO3 accumulation and on protein percentage in leaves was significant in both cuts and in both seasons.

Table 8: Effect of rates of nitrogen sources (mineral "M" and organic "O") on chemical composition of jew's mallow leaves in the first and second cuts during 2004 and 2005 seasons.

Nitrogen sources	N accumulation (mg/plant leaves)		P accumulation (mg/plant leaves)		K accumulation (mg/plant leaves)		NO_3 accumulation (mg/kg dry wt)		Protein (%)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
First cut										
100% M	2539 a	2481 a	343 a	333 a	3056 a	3005 a	576 a	569 a	19.1 a	18.5 a
75%M+25%O	2207 b	2183 b	320 ab	319 a	2769 ab	2767 ab	523 b	516 b	18.5 a	17.8 b
50%M+50%O	1917 c	1887 c	308 b	306 a	2525 b	2505 b	458 c	451 c	17.8 b	17.2 c
25%M+75%O	1572 d	1557 d	224 c	217 b	1887 c	1902 c	373 d	368 d	16.6 c	16.0 d
100%O	1292 e	1306 e	171 d	173 c	1542 d	1576 d	191 e	187 e	15.3 d	14.7 e
Second cut										
100% M	3944 a	4546 a	576 a	670 a	5355 a	6229 a	629 a	612 a	16.6 c	16.0 c
75%M+25%O	3837 a	4233 b	570 a	632 a	5137 a	5728 b	565 b	555 b	17.2 b	16.6 b
50%M+50%O	3760 a	4049 b	566 a	612 a	4564 b	5414 b	490 c	480 c	17.8 a	17.2 a
25%M+75%O	2570 b	26637 c	363 b	372 b	3241 c	3359 c	395 d	391 d	15.3 d	14.7 d
100%O	2080 c	2108 d	281 c	282 c	2591 d	2588 d	204 e	202 e	14.1 e	14.1 e

Means followed by a common letter in the same column and in the same cut do not differ significantly by Duncan's Multiple Range Test, 5% level.

The highest values of N, P and K accumulation were obtained from using 100% mineral N, while the lowest values were obtained from using 100% organic N in comparison with other treatments. These results may be attributed to the high capacity of the plants supplied with mineral nitrogen in building metabolites, which reflect on more growth (Table 7), which in turn contribute much to the increase of N, P and K accumulation. On the contrary, when plants supplied with chicken manure as organic N, nitrogen release was very slow and not enough to the growth of plants. On the other hand, there were insignificant differences among 100% mineral N, 75% mineral N + 25% organic N, and 50% mineral N + 50% organic N treatments in N and P accumulation in second cut. These results may be due to the slow release and increasing of nutrients from chicken manure during decomposition and crop growth (Sharpley and Smith, 1995). Moreover, these results are in agreement with those obtained by Brahmachari and Mondal (2000), who found that the maximum nutrients uptake (N, P and K) were obtained when jew's mallow received both organic and inorganic sources of nutrients.

Regarding NO_3 accumulation (Table 8), raising organic N with decreasing mineral N decreased significantly nitrate accumulation in both cuts and in both seasons. These results can be explained on the steady release of the nitrogen from organic fertilizers (Bulluck *et al.*, 2002) could have results that nitrogen has been taken up mainly in the form of ammonium, which probably caused low nitrate content. These results are in line with those obtained by Hanafy Ahmed *et al.*(1997) on jew's mallow, Premuzic *et al.* (2002) on lettuce and Gent (2002) on spinach who found that the mineral fertilizer treatments had a higher nitrate concentration compared to organic treatments.

Concerning protein percentage, data presented in Table 8 show that, raising organic nitrogen with decreasing mineral nitrogen led to marked decreases in protein percentage in the first cut, while 50% mineral N + 50% organic N treatment had the highest values in the second cut in comparison with other treatments. These findings were true in both seasons. This may be due to the role of mineral nitrogen fertilizer in an increase of N availability, which leads to increase the uptake of N by plants, and consequently, the biosynthesis of protein was increased in the first cut plants. On the other hand, the superiority of 50% mineral N + 50% organic N treatment in increasing the protein percentage in second cut plants may be attributed mainly to the gradual release of available nitrogen from chicken manure.

2.3- Seed yield and its components:

Data in Table 9 show that number of branches/ plant was significantly reduced by increasing organic N with decreasing mineral N in both seasons. These reductions may be resulted from decrease growth in first cut plants (Table 7) which resulted in decrease growth in second cut plants, subsequently, number of branches/ plant decreased.

Also, it can be noticed from Table 9 that, maximum values of number of pods/ plant, seed weight/ pod and seed yield/ fed. were obtained from the treatment of 50% mineral N + 50% organic N in both seasons. The probable reason for these findings may be due to the fact that when N was supplied from both sources of nitrogen (mineral and organic) cations were adsorbed and less leaching occurred (Di and Cameron, 2004), this will enable more pods and seeds to be developed and filling.

Table 9: Effect of rates of nitrogen sources (mineral"M" and organic"O") on seed yield of jew's mallow and its components during 2004 and 2005 seasons.

N sources	No. branches / plant		No. pods / plant		Seed weight / pod (g)		Seed yield (kg/fed.)	
	2004	2005	2004	2005	2004	2005	2004	2005
100%M	3.9 a	4.0 a	12.7 a	13.3 a	0.35 d	0.37 d	868 c	965 c
75%M+25%O	3.6 b	3.8 ab	13.2 a	13.7 a	0.41 bc	0.42 bc	1047 b	1111 b
50%M+50%O	3.3 c	3.5 b	13.0 a	13.6 a	0.47 a	0.48 a	1183 a	1269 a
25%M+75%O	2.7 d	2.9 c	10.2 b	11.3 b	0.43 ab	0.44 ab	872 c	975 c
100%O	2.3 e	2.7 c	8.4 c	10.1 c	0.38 cd	0.40 cd	632 d	751 d

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

2.4- Seed quality:

Data collected in Table 10 indicate that, the effect of rates of nitrogen sources on seed quality (seed index, germination percentage and germination rate) was significant in both seasons. The treatment of 50% mineral N + 50% organic N had the highest values of seed index and germination percentage, and the lowest values of germination rate in comparison with other treatments in both seasons.

Table 10: Effect of rates of nitrogen sources (mineral "M" and organic "O") on jew's mallow seed quality during 2004 and 2005 seasons.

N sources	Seed index		Germination %		Germination rate (day)	
	2004	2005	2004	2005	2004	2005
100% M	1.49 c	1.50 c	93 bc	94 bc	2.9 b	2.8 b
75%M+25%O	1.54 ab	1.55 ab	96ab	97 ab	2.7 cd	2.6 cd
50%M+50%O	1.57 a	1.58 a	98 a	99 a	2.5 d	2.5 d
25%M+75%O	1.52 bc	1.53 bc	94 b	94 bc	2.8 bc	2.7 bc
100%O	1.44 d	1.46 d	90 c	93 c	3.1 a	3.0 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

For seed index, it can suggested that, this treatment may be improved the nutritional status that promoted early flowering and hence longer fruity period, this will enable more pods to be developed and give enough time for seed filling, thus resulting in a heaver seed.

Regarding germination percentage and germination rate, this effect may be due to increase seed weight with high initial food reserves causing greater absolute growth rate of seedling. In this connection, Bhattacharjee *et al.* (2000a) pointed out that increase in the size of seed was beneficial in terms of seed quality.

3- Effect of the interaction between dicyandiamide (DCD) application and rates of nitrogen sources:

3.1- Growth and fresh yield parameters:

The interaction between the two studied factors had significant effects on growth and fresh yield parameters in both cuts and in both seasons. It is clear from Table 11 that, the highest values of these traits were obtained from 100% mineral N and 75% mineral N + 25% organic N under DCD application, while the lowest values were recorded with 100% organic N without DCD. These results were true in both cuts and in both seasons.

In this respect, it can be suggested that, the efficiency of nitrogen use was increased when more nitrogen was supplied as mineral fertilizer combined with DCD, especially in the first cut when available soil nitrogen from chicken manure was relatively low. On the other hand, the high values of growth parameters of these treatments interpret the increase in fresh yield/ fed. for these treatments compared with other treatments.

3.2- Chemical composition:

Data presented in Table 12 indicate that the interaction between dicyandiamide (DCD) application and rates of nitrogen sources had significant effects on all traits of chemical composition in both cuts and in both seasons.

In the first cut, the highest values of N, P, and K accumulation were recorded using 100% mineral N with DCD treatment, while the lowest values for these elements were noticed with the treatment of 100% organic N without DCD in comparison with other treatments, however, there are insignificant differences between 100% mineral N with DCD and 75% mineral N + 25%

organic N with DCD in the first cut , and there are insignificant differences among 100% mineral N, 75% mineral N + 25% organic N, and 50% mineral N + 50% organic N under DCD in the second cut. These pronounced positive effect may be attributed to the role of DCD and chicken manure with mineral N fertilizer in an increase of nutrients availability (Mehana, 1998), which lead to increase the uptake of nitrogen and other nutrients by plants.

Regarding NO_3 accumulation (Table 12), the highest values were recorded with applying 100% mineral N without DCD, while the lowest values were recorded with 100% organic N with DCD in comparison with other treatments in both cuts and in both seasons.

Table 11: Effect of the interaction between dicyandiamide (DCD) application and rates of nitrogen sources (mineral"M" and organic "O") on growth and fresh yield parameters of jew's mallow in the first and second cuts during 2004 and 2005 seasons.

DCD (kg/fed.)	N sources	Foliage fresh weight (g/plant)		Foliage dry weight (g/plant)		Leaves weight (g/plant)		Plant height (cm)		Fresh yield (kg/fed)	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
First cut											
0	100% M	5.9 bc	6.2 b	1.41 ab	1.47 ab	2.6 ab	2.7 ab	39 bc	43 b	1090 b	1139 b
	75%M+25%O	5.3 cd	5.6 b	1.28 bc	1.33 bc	2.4 bcd	2.5 bcd	37 c	37 c	985 c	1006 c
	50%M+50%O	4.7 de	4.9 c	1.14 cd	1.16 cd	2.2 cde	2.2 def	34 d	34 cd	880 d	881 d
	25%M+75%O	4.3 ef	4.5 cd	1.05 d	1.13 d	2.0 ef	2.1 ef	28 ef	30 e	770 e	767 ef
	100%O	4.0 f	4.1 d	0.99 d	1.00 d	1.7 f	1.9 f	27 f	28 e	701 e	726 f
3.2	100% M	6.6 a	6.9 a	1.55 a	1.58 a	2.8 a	2.9 a	43 a	46 a	1209 a	1250 a
	75%M+25%O	6.0 ab	6.2 b	1.42 ab	1.50 ab	2.7 ab	2.8 ab	42 ab	41 b	1115 ab	1145 ab
	50%M+50%O	5.6 bc	5.7 b	1.34 bc	1.36 bc	2.5 bc	2.6 bc	37 c	37 c	1047 bc	1055 bc
	25%M+75%O	4.8 de	4.9 c	1.16 cd	1.15 d	2.2 cde	2.3 cde	33 d	33 d	875 d	874 de
	100%O	4.3 e	4.4 cd	1.05 d	1.09 d	1.9 ef	2.1ef	31 de	32 de	760 e	760 f
Second cut											
0	100% M	11.8 bc	12.9 bc	2.59 bc	2.97 b	5.6 bc	6.3 ad	44 ab	45 ab	2160 b	2360 b
	75%M+25%O	10 5 cd	11.5 cd	2.39 cd	2.65 cd	5.0 cd	5.6 bc	42 bc	43 bc	1931 c	2102 cd
	50%M+50%O	9.6 d	10.5 d	2.26 d	2.42 de	4 7 d	5.2 c	39 cd	39 cd	1778 d	1931 de
	25%M+75%O	7.4 ef	8.1 fg	1.80 fg	1.86 fh	3.7 fg	4.0 de	34 ef	34 ef	1384 e	1495 f
	100%O	6.1 f	6.7 g	1.56 g	1.58 h	3.2 g	3.3 e	30 f	31 f	1165 f	1240 g
3.2	100% M	13.7 a	14.9 a	2.91 a	3.30 a	6.3 a	7.3 a	47 a	47 a	2416 a	2624 a
	75%M+25%O	12.4 ab	13 5 ab	2.78 ab	3.08 ab	6.0 ab	6.6 ab	44 ab	45 ab	2286 ab	2477 ab
	50%M+50%O	11.6 bc	12.6 bc	2.66 abc	2.90 bc	5.6 abc	6.2 b	43 ab	44 ab	2153 b	2324 bc
	25%M+75%O	8.7 de	9.5 ef	2.1 de	2.29 ef	4.4 de	4.7 cd	37 de	37 de	1515 d	1750 e
	100%O	7.3 ef	8.0 fg	1.92 ef	2.05 fg	3.9 ef	4.0 de	34 ef	34 ef	1366 e	1482 fg

Means followed by a common letter in the same column and in the same cut do not differ significantly by Duncan's Multip33.3le Range Test, 5% level.

This may be due to the role of DCD and chicken manure in reducing NO_3 concentration in soil, subsequently, gives the chance for plant to absorb more NH_4-N, thereby reduced NO_3 accumulation in plant.

The previous results are in line with those obtained by Bakr and Gawish (1997), who found that the lettuce and the spinach plants grown under organic and mineral fertilizers with nitrification inhibitor had the highest mineral concentrations with lowest nitrate concentration.

Concerning protein percentage (Table 12), plants received 100% mineral N with DCD had the highest values in the first cut, but plants received 50% mineral N + 50% organic N with DCD had the highest values in second cut. On the other hand, plants received 100% organic N without DCD had the lowest values in both cuts. These results were true in both seasons. This pronounced positive effect may be attributed to the role of mineral nitrogen fertilizer with DCD in the first cut, and to the role of DCD and chicken manure with mineral N fertilizer in the second cut in increasing the availability of N, enhancing its accumulation within leaves tissues mainly in NH4-N form that favorably and rapidly incorporated in amino acids and protein biosynthesis.

Table 12: Effect of the interaction between dicyandiamide (DCD) application and rates of nitrogen sources (mineral "M" and organic "O") on chemical composition of jew's mallow leaves in the first and second cuts during 2004 and 2005 seasons.

DCD (kg/fed.)	N sources	N accumulation (mg/plant leaves)		P accumulation (mg/plant leaves)		K accumulation (mg/plant leaves)		NO_3 accumulation (mg/kg dry wt)		Protein (%)	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
First cut											
0	100% M	2342 b	2291 b	308 bc	300 bc	2986 ab	2947 a	613 a	607 a	18.8 ab	18.1 ab
	75%M+25%O	2006 cd	1988 c	284 cd	284 cd	2651 bc	2655 ab	554 b	546 b	18.1 bc	17.5 bc
	50%M+50%O	1683 ef	1674 d	261 cd	267 cd	2332 cd	2340 bc	480 d	474 de	17.5 cd	16.9 cd
	25%M+75%O	1434 e	1475 de	195 e	195 ef	1793 ef	1870 de	387 ef	382 f	16.3 ef	15.6 ef
	100%O	1181 g	1196 e	156 e	156 f	1454 f	1487 e	195 g	191 g	15.0 g	14.4 g
3.2	100% M	2735 a	2670 a	377 a	365a	3125 a	3062 a	539 bc	531 bc	19.4 a	18.8 a
	75%M+25%O	2407 b	2378 ab	355 ab	353 a	2887 ab	2878 a	492 cd	485 cd	18.8 ab	18.1 ab
	50%M+50%O	2151 be	2100 bc	354 ab	345 ab	2718 bc	2670 ab	436 de	428 e	18.1 b	17.5 bc
	25%M+75%O	1709 de	1638 d	253 d	239 de	1980 de	1934 cd	358 f	353 f	16.9 de	16.3 de
	100%O	1403 fg	1416 de	185 e	189ef	1629 e	1664 de	186 g	183 g	15.6 fg	15.0 fg
Second cut											
0	100% M	3613 b	4100 cd	518 b	590 bc	5121 ab	5871 bc	671 a	658 a	16.3 cd	15.6 cd
	75%M+25%O	3465 b	3822 de	509 b	558 c	4805 b	5366 cd	603 b	589 b	16.9 bc	16.3 b
	50%M+50%O	3362 b	3618 e	495 b	536 c	3744 c	4971 d	517 de	510 de	17.5 a	16.9 ab
	25%M+75%O	2286 d	2369 g	307 d	319 e	2967 de	3111 ef	416 fg	411 fg	15.0 ef	14.4 ef
	100%O	1807 e	1870 h	236 d	247 e	2330 f	2329 g	212 h	209 h	13.8 g	13.8 f
3.2	100% M	4275 a	4992 a	633 a	749 a	5588 a	6586 a	586 bc	578 bc	16.9 bc	16.3 bc
	75%M+25%O	4208 a	4644 ab	631 a	705 a	5469 a	6089 ab	527 cd	520 cd	17.5 ab	16.9 ab
	50%M+50%O	4157 a	4480 bc	637 a	688 ab	5383 ab	5856 bc	462 ef	450 ef	18.1 a	17.5 a
	25%M+75%O	2854 c	2904 f	418 c	424 d	3514 cd	3606 e	374 g	370 g	15.6 de	15.0 de
	100%O	2353 d	2346 g	326 d	316 e	2852 ef	2846 fg	195 h	194 h	14.4fg	14.4 ef

Means followed by a common letter in the same column and in the same cut do not differ significantly by Duncan's Multip33.3le Range Test, 5% level.

3.3- Seed yield and its components:

There was a significant effect of the interaction between dicyandiamide (DCD) application and rates of nitrogen sources on seed yield and its components in both seasons (Table 13). The highest number of pods/ plant, seeds weight/ pod and seed yield/ fed. of jew's mallow plants were obtained from plants grown in soil treated with 50% mineral N + 50% organic N combined with DCD, while the lowest values of these traits were obtained with the treatment of 100% organic N without DCD in comparison with other treatment in both seasons.

This pronounced positive effect may be attributed to the effect of DCD and chicken manure on increasing use efficiency of nutrients by the slow release of nutrient from chicken manure and the added mineral fertilizer. In support of this, Bhattacharjee *et al.* (2000b) reported that gradual increase in the level of NPK fertilization increased growth and seed yield of jew's mallow. Also, Deleuran *et al.* (2005) found that a high N concentration in the plants at the start of growth showed negative effects on final seed yield of spinach, whereas later in the season there was a significantly positive correlation between N concentration in plants and seed yield.

Table 13: Effect of the interaction between dicyandiamide (DCD) levels and nitrogen sources (mineral "M" and organic "O") on seed yield of jew's mallow and its components during 2004 and 2005 seasons.

DCD (kg/fed.)	N sources	No. branches / plant		No. pods / plant		Seed weight / pod (g)		Seed yield (kg/fed.)	
		2004	2005	2004	2005	2004	2006	2004	2005
0	100% M	3.7 ab	3.8 ab	11.9 c	12.7 bcd	0.34 b	0.36 d	788 de	898 c
	75%M+25%O	3.4 bc	3.6 bc	12.2 bc	12.9 bc	0.39 bcd	0.40 bc	928 cd	1012 bc
	50%M+50%O	3.1 cd	3.3 cd	11.6 c	12.5 bcd	0.45 ab	0.46 ab	1020 bc	1131 b
	25%M+75%O	2.6 ef	2.8 ef	9.6 de	10.7 ef	0.42 ab	0.43 abc	797 d	908 c
	100%O	2.2 f	2.4 f	7.9 f	9.0 f	0.37 cd	0.39 cd	577 f	672 d
3.2	100% M	4.1 a	4.2 a	13.5 ab	13.9ab	0.36 cd	0.38 d	948 cd	1031 bc
	75%M+25%O	3.8 a	3.9 ab	14.2 a	14.5 a	0.42 abc	0.43 abc	1165 ab	1209 ab
	50%M+50%O	3.4 bc	3.6 bc	14.3 a	14.6 a	0.48 a	0.49 a	1345 a	1406 a
	25%M+75%O	2.8 de	3.0 de	10.9 cd	11.8 cde	0.44 ab	0.45 abc	946 cd	1042 bc
	100%O	2.4 ef	2.6 ef	8.9 ef	11.1 de	0.39 bcd	0.40 bcd	687 ef	830 cd

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

3.4- Seed quality:

The results in Table 14 show that, the interaction between dicyandiamide (DCD) application and rates of nitrogen sources had significant effect on seed quality traits in both seasons.

Table 14: Effect of the interaction between dicyandiamide (DCD) levels and nitrogen sources (mineral "M" and organic "O") on jew's mallow seed quality during 2004 and 2005 seasons.

DCD (kg/fed.)	N sources	Seed index		Germination %		Germination	
		2004	2005	2004	2005	2004	2005
0	100% M	1.47 ef	1.48 def	92 bcd	93 bc	2.9 abc	2.8 abc
	75%M+25%O	1.52 bcd	1.53 bc	95 abc	96 abc	2.7 cd	2.6 cde
	50%M+50%O	1.55 ab	1.56 ab	97 a	98 a	2.6 de	2.5 de
	25%M+75%O	1.49 de	1.51 cde	92 bcd	93 bc	2.9 abc	2.9 ab
	100%O	1.43 f	1.45 f	89 d	92 c	3.1 a	3.0 a
3.2	100% M	1.50 cd	1.52 bcd	94 bc	94 bc	2.8 bcd	2.7 bcd
	75%M+25%O	1.55 ab	1.56 ab	96 ab	97 ab	2.6 de	2.5 de
	50%M+50%O	1.58 a	1.59 a	99 a	99 a	2.4 e	2.4 e
	25%M+75%O	1.54 abc	1.55 abc	95 abc	95 abc	2.6 de	2.5 d
	100%O	1.45 f	1.47 ef	91 cd	93 bc	3.0 ab	3.0 a

Means followed by a common letter in the same column do not differ significantly by Duncan's Multiple Range Test, 5% level.

Also, it can be noticed that plants received 50% mineral N + 50% organic N with DCD had the highest means for seed index and germination percentage and the lowest means for germination rate in comparison with other treatments in both seasons.

These results may be due to the role of DCD and chicken manure with mineral N fertilizer in improving the nutritional status, and hence it resulted in an increase in seed weight, which interpreted the increasing in seed quality.

Conclusion

Generally, it could be concluded that, application of nitrogen fertilizer in the form of 75% mineral N + 25% organic N or 50% mineral N + 50% organic N combined with DCD in jew's mallow fields were the most effective treatments for satisfactory increments in fresh and seed yields and qualities, minimizing the accumulation of nitrate and saving the environmental from the chemical pollution with keeping the health of human.

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تأثير السماد النتروجيني العضوي والمعدني والداي سيان داي أميد (كمثبط للتأزت) على المحصول الخضري والبذري للملوخية.

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**معهد بحوث الأراضي و المياة و البيئة - مركز البحوث الزراعية- الجيزة- مصر

أقيمت تجربتان حقليتان في المزرعة البحثية بالبرامون، بمحافظة الدقهلية خلال الموسمين ٢٠٠٤ و٢٠٠٥ لدراسة تأثيرمثبط التأزت الداي سيان داي أميد بمستويين (صفر و ٣، ٢ كجم/فدان) كقطع رئيسية ومصادر النتروجين (١٠٠% ن معدني، ٧٥% ن معدني + ٢٥% ن عضوي، ٥٠% ن معدني + ٥٠% ن عضوي، ٧٥ ن معدني + ٢٥% ن عضوي، ١٠٠% ن عضوي من المعدل الموصى به و هو ٨٠ كجم ن للفدان) كقطع شقية و كذلك التفاعل بينهما على المحصول الخضري و مكوناته و المحتويات الكيميائية في الورقة (تراكم النروجين و الفسفور و البوتاسيوم و النترات، النسبة المئوية للبروتين) و الحصول البذري و مكوناته و كذلك صفات الجودة للبذرة (وزن ١٠٠٠ بذرة، نسبة الإنبات، سرعة الإنبات). استخدم تصميم القطع المنشقة مرة واحدة في ثلاث مكررات كاملة العشوائية. أوضحت النتائج أن استخدام الداي سيان داي أميد أدى إلى حدوث زيادة معنوية في جميع الصفات المدروسة فيما عدا تراكم النترات في الأوراق التي انخفضت بإضافته في كل من الحشتين الأولى و الثانية في كلا الموسمين. أثرت مصادر النتروجين معنويا على جميع الصفات المدروسة، بزيادة نسبة النتروجين العضوي و خفض نسبة النتروجين المعدني انخفضت صفات النمو و المحصول الخضري في كل من الحشتين الأولى و الثانية في كلا الموسمين، و مع هذا أعطت المعاملة ٥٠ % ن معدني + ٥٠% ن عضوي أعلى القيم لكل من عدد القرون للنبات و وزن البذور في القرن و محصول البذور للفدان و وزن ١٠٠٠ بذرة و نسبة الإنبات و سرعة الإنبات في كلا الموسمين. كذلك أثر التفاعل بين عاملي الدراسة معنويا على جميع الصفات المدروسة في كلا الموسمين. بصفة عامة يمكن استنتاج أن إضافة النتروجين في صورة (٧٥% ن معدني + ٢٥% ن عضوي) أو (٥٠ % ن معدني + ٥٠% ن عضوي) مع إضافة الداي سيان داي أميد إلي حقول الملوخية أدى إلى إنتاج محصول خضري و بذري مناسب و جيد مع تقليل تراكم النترات و بالتالي المحافظة على صحة الإنسان و سلامة البيئة.