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Effect of miraculan of seed germination parameters in Cowpea under water stress

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ABSTRACT

A study was conducted to see the effect of Miraculan (Triacontanol) on various seed germination parameters under water stress. The experiment revealed that the speed of germination and seedling growth parameters showed better increment with lower concentrations (0.1 to 0.8ml/L) than higher concentrations (1.0 to 1.6ml/L) of Miraculan. Thus, 0.6ml/L proved to be most beneficial for the enhancement of seed germination parameters, hypocotyl length. While, 0.2ml/L showed maximum increase in radicle length & 0.8ml/L showed maximum Emergence Index. Thus, for all the parameters lower concentrations proved to be beneficial for increasing seed germination and seedling growth.

Key words: Seed germination, water stress, Miraculan

INTRODUCTION

In predominantly rural and agricultural countries like India, agricultural progress is the most effective social safety net against hunger and poverty. Hence, the ongoing fatigue for the "green revolution" in major crops should be converted into an "evergreen revolution" designed to promote productivity improvement without ecological harm. (Swaminathan, 2003,2006,2007,2008a & b). During the next half century, the population of Asia will be from 3.7 billion to 5.3 billion. The balance between world food supply and population in more prosperous countries affects everyone. Insufficient or more costly food production results in higher food prices. India's population is growing at the rate of above 1.8 percent a year. India is facing a lasting crisis in agriculture and a serious threat to its food security (Malone, 2009).Besides, the population increase, improved purchasing power associated with economic growth will enhance the demand for agriculture crops. Plant productivity is thus of vital importance not only for food production, but also for material for food production.

Higher, more nutritious, yield, shorter growing seasons and greater synchrony in development and maturity are desirable. Further, per capita availability of arable land is also declining. At the same, input use efficiency is relatively low despite incrased irrigation and fertilizers use. On the basis of trend in population increase, the surest and cheapest ways of increasing the availability of food or vegetable crop is to apply some eco-friendly methods, like judicious application of some important agrochemicals (Ries *et al.,*. 1983;Ries and Houtz, 1983; Ries,19851991; Malik *et al.,* 1987; Yadav *et al.,* Setia *et al.,*, 1991; Raghave and Raghava, 1990,1991;Ansari *et al.,* 2001; Gupta *et al.,*; 2002; Khan *et al.,* 2006).

TRIA has been reported to stimulate seedling growth I tomato, rice, corn and barley (Ries and Wert, 1977; Ries *et al.,* 1977). Bittenbender *et al.,*. (1978) observed that when TRIA applied to IR-8 rice seedling in nutrient solution caused an increase in dry weight during a 6-hour dark period. By reviewing the current literature, the least work has been found on the effect of TRIA on leguminous

plants. Therefore, the work has been carried out on seedling growth parameters of cowpea, an important vegetable as well as fodder crop.

MATERIAL AND METHODS

The Germination Experiment was conducted in the laboratory in the year 2005, March to April (3 sets) on cowpea [Vigna unguiculata (L) Walp. Family-Fabaceae; Var.Gomati (vu-89)] The first Secreeing experiment form 10th March to 25th march, second from 15th to 30th March and third from 20th March to 4th April 2005 was conducted. Before soaking the seeds were surface-sterilized with 0.1%$HgCl_2$ for a minute. The selected seeds were treated with different concentrations of Mircalun (0.1,0.2, 0.4, 0.6, 0.8, 1.0., 1.2, 1.4, 1.6, and 1.8 ml/L) against control. After this, the treated as well as untreated control seeds were soaked in Petridishes on filter paper (three layers).The Distilled Water (DW) is added to the control set every third day till the date of observation. While, in treated sets no water is added to create stress. The observations were recorded after one day till 11 days after treatment continuously. Following Seedling Growth parameters were determined at final day of observation.

Germiniability of % seed germination = (Number of seeds germinated / Total number of seeds) x 100

Standard germination test (SGT) was calculated as Germination Rate Index and Speed of germination

Germination Rate Index and speed of germinations were calculated according to the formula of Magurie (1962)

Germination Rate Index (GRI)

GRI = No. of normal seedling of days x/DaysX
X = No. of days from seed sowing

Speed of germination (SG)

$$SG = n/t$$

Where,
n = number of seeds emerged in the day
t = time or days from sowing

Coefficient of velocity of germination (CVG)

CVG = (sum of n/sum of t) x 100

Where
n = number of seeds emerged on the day
t = time of days from sowing.

Emergence Index (EI) was calculated by the formula of by Baskin (1969).

$$EI = (n_1/dn_1)+ (n_2/dn_2)+ (n_3/dn_3) \ldots\ldots\ldots(n_x/dn_x)$$

Where
n = number of seeds emerged in the day 1st, 2nd,3rd,—nth day.
dn= number of days from the day of sowing.
dn_x= number of days to the final count.

Relative seed germination =

No. of seeds germination in the Treatment /
No of seeds germination in the control

Relative root elongation =

Mean root elongation in the treatment /
Mean root elongation in the control x 100

Growth Index

It was calculated by the formula of Tam and Tiqria (1994).

Seedling growth =

$$\frac{\text{Total seedling Growth length \{cm\}}}{\text{Germination of seeds}}$$

Viguor Index =

Germination % x Total seedling length,

It was calculated by the formula of Abdul-Baki and Anderson (1973).

RESULTS

Seeds Germination and Seedling Growth

The First screening experiment was conducted to observe the seed germination and seedling growth of cowpea var. Gomati under lab conditions in Petridishes. The results are expressed in Table 1. The observation showed remarkable effect on Mirculan with out water addition on germination and seedling growth of cowpea. Germinability (G%) increased more with lower concentrations of Miraculan than higher concentrations and the maximum increase was

Table 1: Effect of Miraculan (Triacontanol) on different parameters of Seed germination and Seedling growth in Cowpea (var-Gomati (vu-89) at 11th Days After Soaking (All the values are an average of three replicates)

Parameters Conc.ml/L	Germibability (G%)	Relative Seed Germination (RSG)	Germination Rate Index (GRI)	Speed of Germination (SG)	Coefficient Velocity Gremination (CVG)	Hypocotyls Length(cm)	Radicle Length (cm)	Total Seedling Length (cm)	Relative Roof Elongation (RRE)	Seedling Growth	Vigour Index. (VI)	Emergency Index (EI)
Con	90	-	77	0.64	110.00	8.5	6.0	14.5	-	17.68	1015	6.25
0.1	90	81.82	99	0.82	120.00	8.5	6.0	14.5	100.00	15.93	1450	7.70
0.2	90	81.82	99	0.82	120.00	10.0	7.0	17.0	116.67	20.73	1530	7.72
0.4	100	91.91	110	0.91	120.00	10.5	5.5	16.0	83.66	19.51	1440	7.72
0.6	100	91.91	110	0.91	130.00	11.0	5.0	16.0	83.66	17.58	1600	8.22
0.8	70	63.63	77	0.64	110.00	7.5	4.5	12.0	75.00	18.75	840	7.81
1.0	60	54.55	66	0.55	86.67	7.0	4.0	11.0	66.67	20.00	660	5.82
1.2	60	54.55	66	0.55	86.67	6.5	4.0	10.5	66.67	19.09	630	5.82
1.4	50	45.45	55	0.45	80.00	6.0	3.5	10.0	58.33	22.23	500	5.60
1.6	50	45.45	55	0.45	80.00	5.0	3.5	8.5	58.33	18.89	425	5.60

noted with 0.4% & 0.6ml/L (100%). The higher concentrations reduced almost 50% germination. The maximum Relative seed germination also increased with two concentrations (0.4 & 0.6ml/L) i.e. 91.91 The maximum Germination Rate Index (GRI) was observed with 0.4% & 0.6ml/L i.e. 42.86% over control, while higher concentration from 1.0 to 1.6ml/L GRI was reduced significantly. The speed of Germination (SG) was enhanced with lower concentrations of Miraculan (0.1, 0.2, 0.4, & 0.6 ml/L), while higher concentration reduced it. The increase was 0.82 to 0.91 as compared to control (0.64). The maximum increase in SG was recorded in two concentrations i.e. 0.4 & 0.6 ml/L i.e. 0.91 (Table-A) The maximum Coefficient Velocity of germination (CVG) showed increase with 0.6ml/L i.e. 130, over control (i.e. 110).

The hypocotyl length also increased with 0.4 and 0.6ml/L i.e. 10.50cm and 11cm i.e. 1.23 & 1.29 fold, respectively, as compared to control (8.50 cm). The maximum increase of hypocotyl length was 35.9% over control. While, the maximum enhancement noted in radicle length with 0.2ml/L i.e. 16.67 over control. The maximum total seedling growth was recorded with 0.2 ml/L i.e. 17.24 % over control. As the concentrations of Miraculan increased from 0.2ml/L to 0.6ml/L, the hypocotyl length was increased, but radicle length gradually reduced as compared to control (Table-A and Plate-3) & 4). The relative root elongation (RRE) increased with 0.2ml/L i.e. 116.67 and beyond this, from 0.4 to 1.6ml/L showed less RRE (Table-A) The seedling growth (SG) was observed maximum with 0.2 ml/L and there after reduced slightly. Again the higher concentrations (1.0 and 1.4 ml/L) showed some stimulatory effect for increasing SG. The maximum Vigour Index (VI) recorded the VI. Emergence index (EI) was also increased with 0.6ml/L i.e. 31.52% over control. Overall, the speed of germination and seedling growth parameters showed better increment with lower concentrations (0.1 to 0.8ml/L) than higher concentrations (1.0 to 1.6ml/L) of Miracalun. Thus, 0.6ml/L proved to be most beneficial for the enhancement of seed germination parameters, hypocotyl length. While, 0.2ml/L showed maximum increase in radicle length & 0.8ml/L showed maximum Emergence Index. Thus, for all parameters lower concentrations proved to be beneficial for increasing seed germination and seedling growth under water deficient conditions.

DISCUSSION

Present investigation showed that Miraculan significantly enhanced the seed germination and seedling growth in cowpea. The lower concentrations 0.4 and 0.6ml/L enhance the Germination rate index, relative root elongation. Vigour Index (VI). Germ inability, etc.These parameters are also showed the enhancement in the Speed of Germination, Coefficient Velocity, and Emergence Index, which ultimately affects the total seedling length. These studies are similar to the studies of Ries and Wert (1977), Ries *et al.,*. (1977). Bittenbender *et al.,* (1978) and Jones *et al.,*. (1979). in rice seedling. The lower concentrations prove to the beneficial for increasing seedling growth (Henry and Kanaby, 1988: Janardhan, 1992: Ni *et al.,* 1995; Rajasekaran and Blake, 1999; Raichur et at., 2001; Chen *et al.,* 2002).

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