Effects of Priming Tests and Fertilizer applications on Germination, Growth and Yields of Chilli (*Capsicum annuum* L.)

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Abstract

A study on the morphological characters and the effects of hydro-priming treatment on germination of chilli (*Capsicum annuum* L.) was carried out at Botany Department of Hinthada University. The results showed that warm water (at 40· C) has highly significant effects on the germination of chilli at 4DAS, 7DAS and 14DAS. The priming test on germination and effects of different fertilizers (urea, ash, cowdung, EM and poultry) on growth and yields of chilli from September, 2015 to March, 2016. Among the fertilizers, plant height and number of leaves of chilli were the highest in cowdung application but number of flowers and fruits were the highest with EM fertilizer for chilli. EM fertilizer application was the most suitable fertilizer for chilli because of the highest number of fruits in growing periods.

Keywords: Chilli, Priming Test, Fertilizer

Introduction

Chilli (*Capsicum annuum* L.), is an annual crop that originated from Central and South America. *Capsicum* is so widely cultivated that African populations consider chilli as a fruit vegetable or as a traditional condiment.

Seed priming is a pre-sowing development at a later stage by nodulating pre-germination metabolic activity prior to protrusion of the radicle.

Seed treatment with micronutrients solutions has the potential to meet crop micronutrient requirement and improve seedling emergence and stand establishment, yield and seed micronutrient enrichment.

Chilli (*Capsicum annuum*) is cultivated on a large area in Pakistan for its fresh fruit as well as spice production (Anonymous, 2006).

Capsaicin, the main constituent causing hotness helps in digestion and prevents heart diseases. Chilli production in Pakistan not only fulfils domestic demand but also helps in earning foreign exchange. Delayed and non-uniform germination and poor emergence are the characteristic problem in chillies (Demir & Okcu, 2004).

Seed priming is a technique of seed enhancement that improves germination or seedling growth and rate or uniformity of the seedling establishment. Among the abiotic stresses, salinity is a major limiting factor in crop productivity all over the world (Ashraf & Munns, 2002).

High yield of *Capsium* has been obtained in the tropics mainly through the use of improved genotypes fertilizer and good cultural practices. Inorganic fertilizers are relied upon to improve crop yields and maintain soil fertility. However, the wide use of these fertilizers is hampered by their high costs and the highly variable vegetable crops. Fertilizer is one of the major factors of crop production.

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Materials and Methods

Preparation for the Morphological Study

Chilli (*Capsicum annuum* L.) was grown in Hinthada District. And their morphological characters were studied. The morphological characters of the fresh sample plants were examined with a disserting set by cutting their flowers by blade. The floral parts from the flower specimens were studied under the microscope and the results were recorded immediately. All fresh specimens were recorded by taking the photographs while doing study.

Experiment 1

Time and place of experiment

The laboratory experiments on seed priming were conducted from March, 2014 to July, 2014 at Botany Department of Hinthada University.

Preparation for priming test on germination of chilli

Test for water priming (Hydro-priming)

Seeds were primed by soaking in normal water (NW) and in warm water (WW, 40˚C). The seeds were treated by soaking and shaking the container hourly. At the end of the treatment, the solutions were decanted and seeds were rinsed twice with double distilled water. Then, the seeds were blot dried with tissue paper and allowed to dry in a shed. About 25 seeds were sown in a sand tray to study germination and then the germination percentages of hydropriming in chilli seeds were calculated.

Preparation for chemical priming

Seeds of chilli were primed by being dipped in 5g/Lof chemical solutions (Borax, $KMnO_4$, Darkarmone hormone, $CuSO_4$, NaCL, NaOH,KNO_3, Gibberellic/A, H_2O_2) for 24 hours and rinsed two to three times in distilled water and dried on filter paper. About 25 primed seeds were sown in sand tray to study the germination (at 7 DAS) and the survival rates (at 14 DAS) and then the germination percentages of various micronutrient priming chilli seeds were calculated. Data concerning germination and survival percentages at micronutrient priming were recorded and then compared to the previous experimental data (hydropriming data) of chilli seeds.

Preparation for comparison of chemical priming and hydropriming

The experiment was conducted during the period of November, 2014 to January, 2015. The seeds of chilli (*Capsicum annuum* L.) were primed in 10 g/L of NaCl and GA_3, and warm water. The seeds were treated by soaking in each priming solution, shaking the container hourly. At the end of the treatment, the solutions were decanted and seeds were rinsed twice with distilled water. Then, the seeds were blot dried with tissue paper and allowed to shed at room temperature. The treated seeds were sown in each pot which filled with 60 kg garden soil.Three treatments (NaCl, GA_3 and warm water) along with a control (without priming) were imposed on a local variety of chilli. Primed and unprimed seeds were sown in each clay pot and then measured. Agronomic characters of chilli were measured at 14 days intervals. Watering was done daily and other cultural practices were done whenever necessary.

Experiment 2

Time and Place of this research

This study was carried out at Department of Botany, Hinthada University from September, 2015 to March, 2016.

Preparation of seedling before transplanting

The cultivated seeds were soaked in 5g/L of NaCl for 24 hours and then seeds were surface dried on a piece of tissue paper for a few minutes. The treated seeds were sown in the sandy loam soil filled with seedling trays after 6 weeks until the transplant action of seedling. Each pot was filled with 6Kg sandy loam soil for each treatment. In each treatment, 2Kg of ash, cowdung, EM and poultry were filled in each pot but only 5 g of urea was added in each treated pot because of its being inorganic fertilizer.

Six weeks after sowing, the chilli seedlings (6 inches sized plants) were taken separately from seedbed and were transplanted in the readymade experimented pots in each treatment. The seedlings were watered after being transplanted. When the seedlings were established, the soil around the base of seedling was pulverized. Gaps filling, weeding, irrigation and pest management were done as per requirement. Plant height, number of leaves, number of branches, number of flowers and fruits were counted starting from 2 weeks after being transplant till the harvested time of chilli plants. All data in each treatment were calculated and compared to evaluate the best results in this study of chilli.

Results and Discussion

Scientific name - *Capsicum annuum* L.

English name - Chilli, pepper

Myanmar name - Nga-yoke-shel

Family - Solanaceae

Morphological characters of chilli

Solanaceae family is primarily distributed in the tropical and temperate region. There are about 90 genera and about 2000 to 3000 species present in the family. Habit- erect herb, subshrub, up to 50 cm tall, much branched (9-12), grown as an annual, taproot strong, lateral roots numerous, stem irregular angular, green to brown green and with purplish spots near nodes. Leaves - simple, alternate petiole up to 3cm long, blade ovate, acute apex, entire margin, glabrous, pale to dark green, exstipulate. Flower - solitary, terminal and axillary, bisexual, regular, actinomorphic, pentamerous, pedicel up to 2.5cm long, hypogynous. Calyx - (5), synsepalous, valvate, cup-shaped, sepaloid, persistent and enlarging in fruit,usually with conspicuous teeth, inferior. Corolla - (5), synpetalous, corolla tube short, lobes ovate, petaloid (white) ,imbricate, inferior.Androecium - 5, apostemonous, petalostemonous, adnate at base to corolla tube, long anther with groove, filament short, introrse, longitudinal dehiscence, inferior. Gynoecium- (2), syncarpous, bilocular, axile placentation, many ovules in each locule in T. S, style long and slender, stigma capitate, superior. Flowering period – continuous flowering starts 60-90 days after sowing.

Experiment 1

Germination and survival percentages of chilli seeds among micronutrient priming solutions and hydropriming

Germination and survival percentages of chilli seeds primed by micronutrient solution and hydropriming were shown in Table 1. Chilli seeds treated with NaCL and gibberellic acid solution showed 96% in germination and survival percentages at 7 days after sowing and 100% at 14 days after sowing. Effect of seed priming was assessed on hydropriming with normal water (NW) and warm water (WW) improved protrusion significantly. The primed seeds with warm water (40˚C) were more emergent than other treatment. The effects of seed priming with warm water were found to be the best.

Table 1. First emergence, germination and survival percentage of various micronutrient priming solutions in chilli seeds

Priming solutions	Germination and survival percentages (%)		
	FED (5DAS)	7 DAS	14 DAS
Control	-	28	100
Borax	-	16	72
$KMnO_4$	-	80	100
$CuSO_4$	-	16	100
NaCL	-	96	100
NaOH	-	32	80
Dakarmone hormone	-	0	0
Gibberellic/A	-	96	100
KNO_3	12	80	100
H_2O_2	-	0	0
Warm water (WW)	40	100	100

DAS = Days after sowing

FED = First Emergence Day

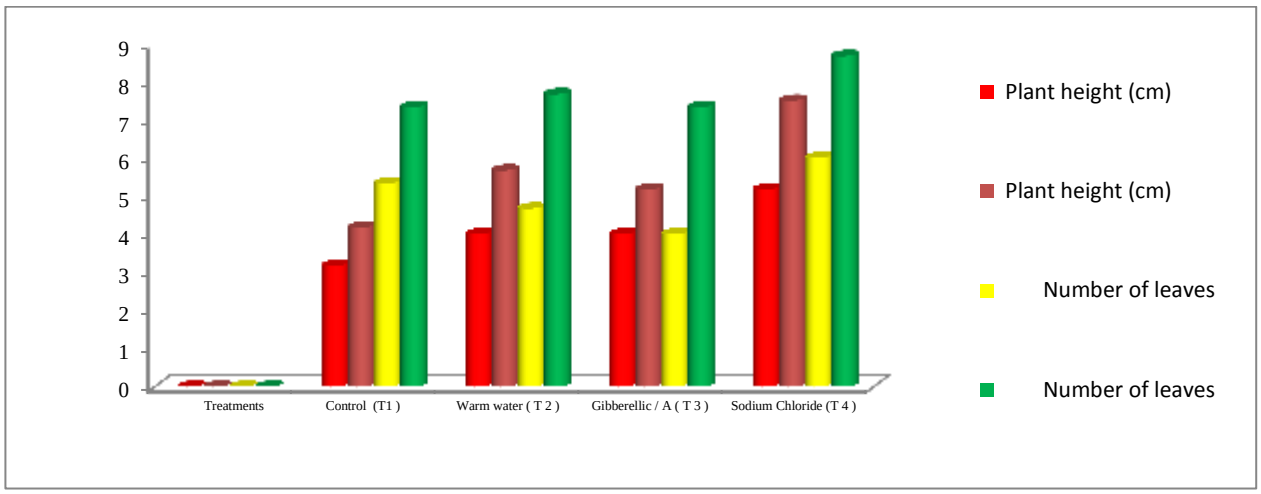
Effects of Priming solution of NaCl, GA_3 and warm water on Vegetative Growth of Chilli (C*apsicum annuum* L.)

Plant height and number of leaves of chilli

The results given in Table 2 indicated the growth characters with significant differences in plant height and number of leaves at 4 weeks, 6 weeks and 8 weeks after sowing. The plant heights of chilli were found to be the highest plant in sodium chloride priming solution. The maximum number of leaves was found in plants with sodium chloride priming solution of chilli.

Table 2. The effects of priming treatments on plant height and number of leaves of chilli

Treatments	Plant height (cm)		Number of leaves	
	At 4 weeks	At 6 weeks	At 4 weeks	At 6 weeks
Control (T1)	3.17	4.17	5.33	7.33
Warm water (T 2)	4.00	5.67	4.67	7.67
Gibberellic / A (T 3)	4.00	5.17	4.00	7.33
Sodium Chloride (T 4)	5.17	7.50	6.00	8.67



Experiment 2

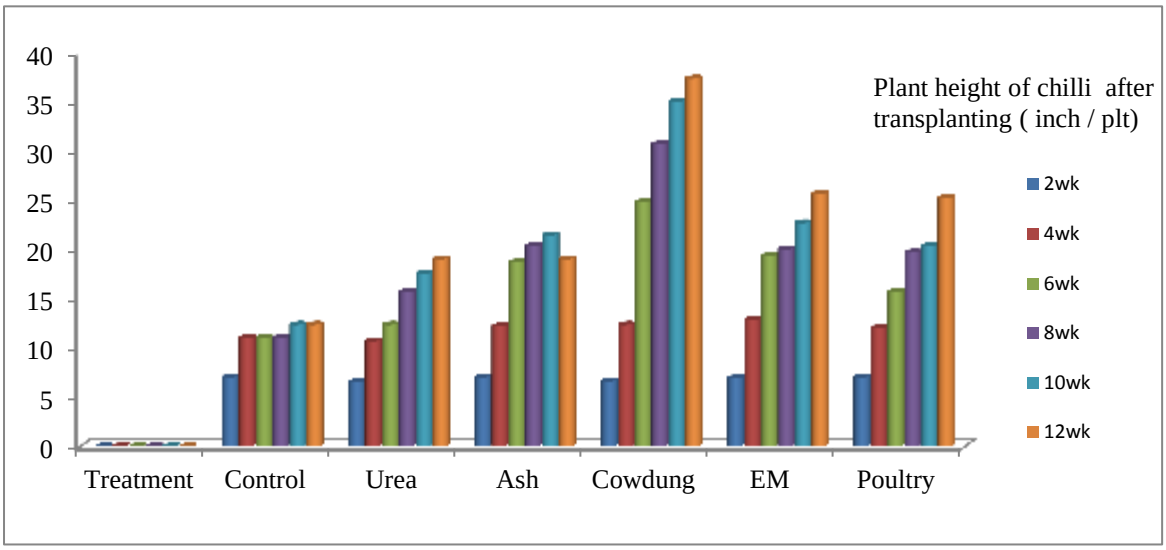
Effects of Different Fertilizer applications on Growth and Yields of Chilli (*Capsicum annuum* L.)

Plant Height of Chilli during growing periods

Plant heights of chilli were presented in Table 3. Among the different fertilizers, the maximum plant height was seen in plants with cowdung fertilizer application followed by EM fertilizer. The heights of plants with poultry, ash and urea applications were much higher than that of control in chilli. The plant heights of five fertilizers application were different by a little parameter to each other but control was the shortest and stunted at 4 weeks after being transplanted.

Table 3. Mean values of Plant Height of Chilli during growing periods

Treatments	Plant height of chilli after transplanting (inch / plt)					
	2 wk	4wk	6wk	8wk	10wk	12 wk
Control	7.00	11.00	11.00	11.00	12.33	12.33
Urea	6.50	10.67	12.33	15.67	17.54	19.00
Ash	7.00	12.17	18.67	20.33	21.42	24.00
Cowdung	6.60	12.33	24.78	30.67	35.00	37.33
EM	6.90	12.83	19.33	20.00	22.67	25.64
Poultry	7.00	12.00	15.67	19.67	20.33	25.21

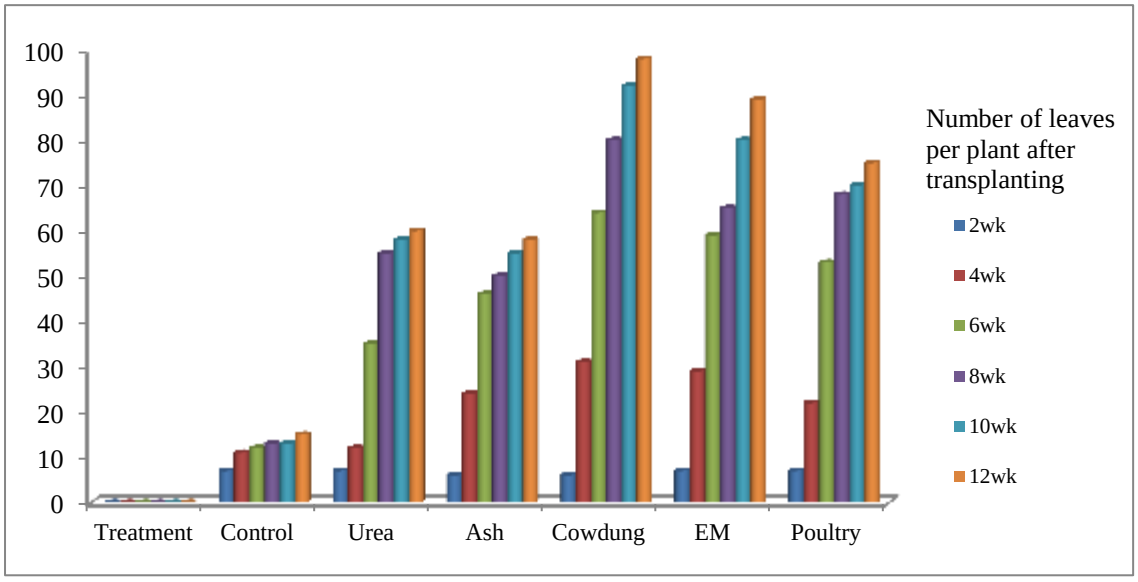


Number of leaves of Chilli during growing periods

Among the different fertilizers, the maximum number of leaves was seen in plants with cowdung fertilizer application followed by EM fertilizer in chilli. The numbers of leaves of poultry, ash and urea applications were higher than control in chilli. The leaf numbers of plants with five fertilizers application were different to one another but control was the smallest number and new leaves do not form at 4 weeks after the transplanting of chill.

Table 4. Number of leaves of Chilli during growing periods

Treatments	Number of leaves per plant after transplanting					
	2 wk	4wk	6wk	8wk	10wk	12 wk
Control	7	11	12	13	13	15
Urea	7	12	35	55	58	60
Ash	6	24	46	50	55	58
Cowdung	6	31	64	80	92	98
EM	7	29	59	65	80	89
Poultry	7	22	53	68	70	75

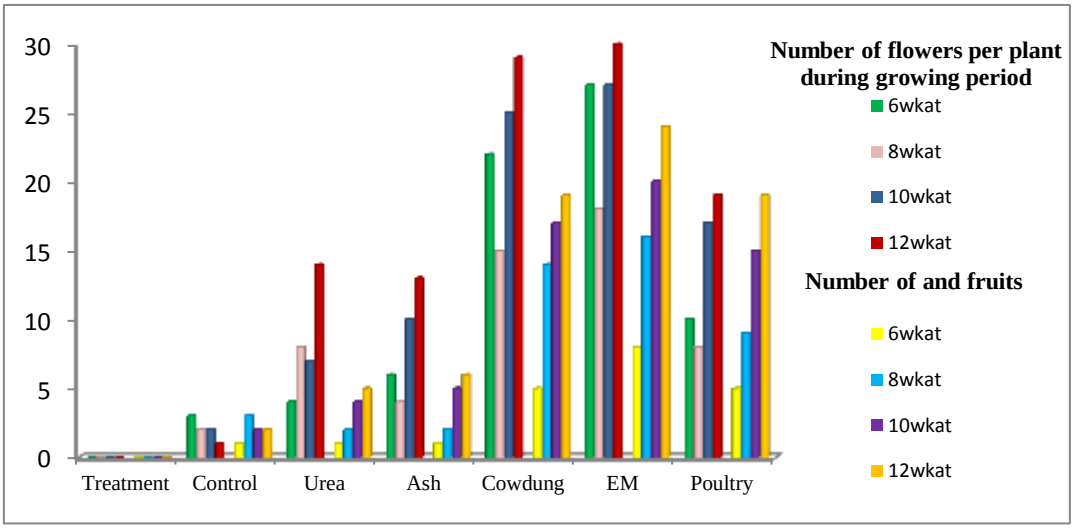


Number of flowers and fruits of Chilli during growing periods

Number of flowers and fruits of chilli were presented in Table 5. Among the different fertilizers, the maximum number of flowers and fruits is seen in plants with EM fertilizer application followed by cowdung fertilizer during the growing periods. The number of flowers and fruits of plant with poultry, ash and urea applications were much higher than control in chilli. The number of flowers and fruits of plants with five fertilizers application were significantly different during the growing period of chilli. The detailed results were shown in Table 5.

Table 5. Mean values of Number of flowers and fruits of chilli during growing periods.

Treatment	Number of flowers per plant during growing period				Number of and fruits per plant during growing period			
	6wkat	8wkat	10wkat	12wkat	6wkat	8wkat	10wkat	12wkat
Control	3	2	2	1	1	3	2	2
Urea	4	8	7	14	1	2	4	5
Ash	6	4	10	13	1	2	5	6
Cowdung	22	15	25	29	5	14	17	19
EM	27	18	27	30	8	16	20	24
Poultry	10	8	17	19	5	9	15	19



Conclusion

In this research, warm water at (40˚C) treatment has the highest germination and survival percentages were found in plants with priming solution with NaCL and Gibberellic acid in chilli. Khan (2009) reported that NaCL and Gibberellic acid priming was much efficient in improving germination and stand establishment of chilli.

Rhodes, 1979 indicated that seed treatment with micronutrients has the potential to meet crop micronutrient requirements and improve seedling emergence and stand establishment, yield and grain micronutrient enrichment.

5g/L of NaCL, Gibberellic acid and warm water (40˚C) were the most appropriate priming solution in the germination of *Capsicum annuum* L. The study revealed that the effects of different organic (ash, cowdung, EM, poultry) and inorganic (urea) fertilizers on growth and yields of chilli were examined from September, 2015 to March, 2016. In all treatments including control, the chilli seedlings were increased in the plant height at 4 weeks after being transplanted which broken down from seedling trays due to seeds priming of NaCl.

In chilli cultivation, fruits are of economic importance all over the world. In the effect of organic manure on yield of chilli, poultry manure and compost gave significantly higher number of fruits and fruits weight compared with the control. Moreover, cowdung manure

will improve tropical soil and plant nutrient composition and the growth and yield of chilli (Ibeawuchi, 2003).

Jegede, 2004, agreed that cowdung ensured more availability of nutrients especially cations in soil and in chilli plant compared with NPK fertilizer. Cowdung is abundant as waste in abattoirs located in urban centers in Nigeria and is often left as waste, it can be put to use as source of nutrients and manure of soil in chilli cultivation.

The study concluded that EM fertilizer application was the most suitable in fruit production of chilli. EM fertilizer based on cowdung manure and fresh grasses (1:1). It can be put as a source of nutrients and manure to chilli production. Therefore, this study should be applied by local farmers in growing not only chilli but also other crops in Myanmar.

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