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Productivity of Potato (*Solanum tuberosum* L.) as Influenced by Calcium Metalosate

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A B S T R A C T

Field trail was carried out at the farm unit, College of Agriculture, Hassan Karnataka during the year 2015 to study the effect of foliar application of calcium metalosate on growth, yield and quality parameters of potato. The experiment consisted of 7 treatments viz., T_1: Control, T_2: Calcium metalosate @ 1 ml/l, T_3: Calcium metalosate @ 2 ml/l, T_4: Calcium metalosate @ 3 ml/l, T_5: Calcium metalosate @ 4 ml/l, T_6: Calmagni @ 2 g/l and T_7: Samras (amino acid mixture) @ 2 ml. The experiment was laid out in randomized complete block design and replicated thrice. Application of calcium metalosate at different concentration had significant influence on productivity of potato. At harvest, application of calcium metalosate @ 4 ml/l (T_5) recorded significantly higher plant height (66.57 cm), more number of leaves (15.33), number of shoots (3.51) at 60 DAP, total dry matter production (52.13 g plant^{-1}), less number of days to 50 % flowering (60 days), number of tubers (6.53 g plant^{-1}), yield (263.29 g plant^{-1}) and total yield (22.54 t ha^{-1}) as compared to control (T_1) which was on par with calcium metalosate @ 3 ml/l (T_4). Same treatment significantly reduced the late blight severity at 60 DAP (19.10 %) and weight reduction 30 days after harvest (10.10 %).

Introduction

Potato (*Solanum tuberosum* L.) belongs to the genus solanum. All cultivated species have been grouped under the series tuberose of sub section potatae. About 72% of the species are diploid (2n=48). The rest are triploid (2n=36), pentaploid (2n=66) and hexaploid (2n=72). The widely cultivated potato belongs to tetraploid species *Solanum tuberosum* L. Potato is one of the most important food crop of the world. This is next to rice, wheat and maize. Potato is the only crop which could supplement the need of food of the country. It is a potential crop which can be harvested and the tuber can be consumed any time after 60 days of planting. The potato contains all major nutrients like proteins, vitamins, calcium, phosphorus and is treasure house of carbohydrates which are essential for the body building. The production potential of potato per unit area and per unit time is higher than most of field crops. So the problems of under and malnutrition can largely be solved if potato is accepted as a major food and not merely as a vegetable in our country. The

potato is a crop which has always been "Poor man's friend" Because potatoes contain large quantity of starch. It is also called as "King of vegetables" because it has huge nutritive value (Per 100 gram of edible matter) mainly moisture (74.7 %), protein (1.6 g), carbohydrates (22.6 g), minerals (0.6 g), fibre (0.4 g), calcium (10.0 g), vitamin A (40 IU) and Vitamin C (17 IU).

The potato is of American origin and has been cultivated in northern Chile and Peru. It was cultivated probably by Portuguese who brought the potato into India. The USSR, China, Poland, India and USA are leading countries in area and production of potato in the world. India stands fourth in area and fifth in production. Potato is cultivated as a versatile crop and can be grown under diverse range of agro-climatic condition. It is a crop of temperate climate and thrives well in cool climate (15.5 ^{0}C to 21.1 ^{0}C). It is cultivated as rainfed crop as well as irrigated crop. High rainfall and humidity are detrimental to this crop. Soil moisture stress results in lower yield of potato. The temperature exercises a marked influence on plant growth and tuber development. Tuberisation is best at 17.7^{0}C and maximum tuber production is takes place at 20 ^{0}C. Crop can be grown in all types of soil except alkaline soil and soil with higher clay content. Sandy loam, loamy soil and sandy soil rich in organic matter are most suitable for potato cultivation. The area, production, productivity of the World is 19.5 million ha, 321 million tonnes, 19.8 t ha^{-1} respectively and of India is 20.63 lakh ha, 455.69 lakh million tones and 22.02 t ha^{-1} respectively. Area of Karnataka is 48,000 ha and production is 6.52 million tones and productivity 14 t ha^{-1}, respectively.

There is scope to enhance the productivity of potato crop by proper agronomic practices like use of proper dosage of fertilizers and at recommended time, disease management etc. Symptoms of micronutrient deficiencies clearly appear on cultivated plants in Karnataka soil because most of these soils are poor in secondary nutrients especially calcium and with low content of organic matter, all these factors lead to a shortage of readiness of micronutrients. Despite the presence in the soil quantities outweigh the need for the plant (Saleh, 2010), The most vegetable crops grown in these conditions suffer from micronutrient deficiencies and there are a clear respons to spray nutrients (Al -Mohammadi, 2005). Kohraee *et al.,* (2011) explained that calcium is essential material for growth and used in small quantities compared to the major nutrients N, P, K and they play an important role in cells division and development, metabolism, respiration increased maturity speed. Alloway (2004) pointed that the use of fertilizers containing calcium element lead to increasing the quantity and improving the quality of potato tubers when calcium activates enzymes and the representation of carbohydrates and proteins manufacturing. Keeping the above points in view, the field trail was conducted to study the response of potato to foliar application of calcium metalosate on growth, yield and quality parameters.

Materials and Methods

The trail was carried out at the farm unit, College of Agriculture, Hassan, which comes under southern Transition Zone (Zone -7) of Karnataka during 2015 on red sandy loam soil with neutral pH (7.1), low soil organic carbon (0.51%), medium available N (345.3 kg ha^{-1}), high available P_2O_5 (54.8 kg ha^{-1}), medium available K_2O (230.0 kg ha^{-1}) and low in available calcium (1.25 meq/ 100 g). This is situated at latitude of 12^0 13' N and 13^0 33' N latitude and 75^0 33' and 76^0 38' E longitude at an altitude of 827 m above mean sea level (MSL). Normal climatic conditions were prevailing during experimental period. The

total rainfall received was 384 mm during the crop season. The average maximum temperature of 33 ^{0}C in the month of May 2015 and the average minimum of 13 ^{0}C during the month of December 2015 was recorded. The mean monthly relative humidity ranged from 83 % in May – June to 86 % in July – August. Overall weather condition prevailed during crop growing period was very good and thus, helped to get good crop stand and optimum yield.

The experiment consisted of 7 treatments viz., T_1: Control, T_2: Calcium metalosate @ 1 ml/l, T_3: Calcium metalosate @ 2 ml/l, T_4: Calcium metalosate @ 3 ml/l, T_5: Calcium metalosate @ 4 ml/l, T_6: Calmagni @ 2 g/l and T_7: Samras (amino acid mixture) @ 2 ml. The experiment was laid out in randomized complete block design and replicated thrice. A potato var. Kufri jyothi was used for experimentation.

The land was ploughed twice by tractor drawn mould board plough and cultivator after harvest of previous crop and on receipt of shower on June 2nd 2015. After harrowing, the land was smoothened with wooden plank. All the plots were dug manually and clods were crushed and leveled.

The plots were demarcated as per layout and bunds were raised around each plot. The recommended dose of N: P_2O_5:K_2O, 125:100:125 kg/ha was applied as per the recommendation and 25 t ha^{-1} of FYM was applied and incorporated three weeks in advance. Hand weeding fallowed by harrowing at 25 days after planting and earthing up was done using plough @ 35 days after planting.

Micronutrient mixtures like Calcium Metalosate, Calmagni and Samras were sprayed at given concentration at 30 DAP (July 5th 2015), 45 DAP ((July 20th 2015), and 60 DAP (August 05th 2015). The crop was given one spray of Dithane M-45 @3g/l and Imidacloprid @ 2ml/l @ 30 DAP. Another spray of Moximate @ 3g/l and Monocrotophos was given @ 2ml/l @ 45DAP another spray of λ-Cyhalothrin and Matco$^+$ @ 60DAP. Crop was harvested at 90 DAP when the foliage turned yellowish brown and started drying. The plants were uprooted by digging carefully without damaging the tubers from the net plots.

Five potato representative plants were sampled at harvest to record growth and yield comparatively and harvesting of potato was done from the net plot for computing tuber yield ha^{-1}. The data obtained from various studies were statistically analyzed following the procedure as described by Gomez and Gomez (1984).

Results and Discussion

Growth parameters

Application of calcium metalosateat different growth stages had significant influence on growth parameters over control. At harvest, among all the treatments, calcium metalosate @ 4 ml/l (T_5) recorded significantly higher plant height (66.57 cm), more number of leaves (15.33), number of shoots (3.51) at 60 DAP, total dry matter production (52.13 g plant^{-1}) and less number of days to 50 % flowering (60 days) as compared to control (54.66 cm, 4.36, 2.92, 41.68 g plant^{-1} and 62 days, respectively). However, it was on par with calcium metalosate @ 3 ml/l (65.21 cm, 14.77, 3.40, 52.08 g plant^{-1} and 60.33 days, respectively) (Table 1). This could be due to the compound effects of many factors, namely additional nutrient, improved soil physical properties, water regimes, better water extraction, aeration and resource use rather than conventional tillage (Unger and Jones, 1998).

Table.1 Growth parameters of potato at harvest as influenced by application of various levels of calcium metalosate

Treatments	Plant height (cm)	Number of leaves	No. of Shoots/plant (60 DAP)	Total dry matter (g plant $^{-1}$)	Days to 50% flowering
T_1: Control	54.66	4.36	2.92	41.68	62.00
T_2: Calcium metalosate @ 1 ml/l	59.62	5.67	3.33	42.61	61.87
T_3: Calcium metalosate @ 2 ml/l	64.75	14.33	3.33	47.47	61.67
T_4: Calcium metalosate @ 3 ml/l	65.21	14.77	3.40	52.08	60.33
T_5: Calcium metalosate @ 4 ml/l	66.57	15.33	3.51	52.13	60.00
T_6: Calmagni @ 1g/l	55.45	7.33	3.37	44.66	61.33
T_7: Samras @ 2 ml/l	53.93	6.85	3.18	41.72	60.67
S.Em±	2.73	0.92	0.36	2.36	0.40
CD (p=0.05)	8.28	2.80	1.08	7.16	1.22

Table.2 Yield parameters of potato at harvest as influenced by application of various levels of calcium metalosate

Treatments	No. of tubers Plant^{-1}	Tuber yield (g plant^{-1})	Tuber grading (t ha^{-1})			Total yield t ha^{-1}
			A <25g	B 25-100g	C >100g	
T_1: Control	5.23	210.49	5.13	8.64	3.40	17.28
T_2: Calcium metalosate @ 1 ml/l	5.73	215.21	5.37	8.97	3.60	17.94
T_3: Calcium metalosate @ 2 ml/l	6.03	239.77	6.52	9.99	3.47	19.98
T_4: Calcium metalosate @ 3 ml/l	6.36	263.01	7.15	11.11	3.66	21.92
T_5: Calcium metalosate @ 4 ml/l	6.53	263.29	7.41	11.37	3.76	22.54
T_6: Calmagni @ 1g/l	6.23	225.57	5.52	9.65	3.63	18.80
T_7: Samras @ 2 ml/l	5.40	207.37	5.16	8.77	3.44	17.54
S.Em±	0.23	11.92	0.46	0.51	0.11	0.99
CD (p=0.05)	0.69	36.15	1.41	1.55	0.33	3.01

Table.3 Disease incidence and weight reduction as influenced by application of various levels of calcium metalosate

Treatments	Late blight Severity (%)		Weight reduction in % (30 days after harvest)
	60 DAP	75 DAP	
T_1: Control	24.12	54.85	13.02
T_2: Calcium metalosate @ 1 ml/l	23.41	54.53	12.05
T_3: Calcium metalosate @ 2 ml/l	20.78	42.63	11.48
T_4: Calcium metalosate @ 3 ml/l	20.10	42.52	10.18
T_5: Calcium metalosate @ 4 ml/l	19.10	42.72	10.10
T_6: Calmagni @ 1g/l	22.15	42.67	10.57
T_7: Samras @ 2 ml/l	21.10	44.25	11.82
S. Em±	1.01	2.59	0.14
CD (p=0.05)	3.07	7.86	0.42

This might be due to optimum availability of nutrients through foliar application of mineral mixture at appropriate growth stage which enhanced rate of photosynthesis and consequently led to better vegetative growth. Increase in dry matter production of tubers occurred at harvest indicating that photosynthates were effectively translocated from haulms to tubers. Increased dry matter in tubers may be attributed to increased leaf area and consequent increase in production of photosynthates and better root growth and spread due to the application of mineral mixture which helped in increasing absorption of nutrients and also translocation of photosynthates to tubers. Similar results were concurred with Krishnamurthy *et al.,* (2002) and Ali *et al.,* (2013).

Yield and yield attributing parameters

Crop growth and productivity are influenced by both external and internal factors. Nutrient management is one such important factor. The yield parameters of potato varied significantly due to application of various levels of calcium metalosate. The higher number of tubers per plant, tuber yield per plant and total yield (6.53, 263.29 g and 22.54 t ha^{-1}, respectively) were recorded with foliar application of calcium metalosate @ 4 ml/l (T_5) which was on par with calcium metalosate @ 3 ml/l (T_4, 6.36, 263.01 g and 21.92 t ha^{-1}, respectively) and these parameters were lower with control (T_1, 5.23, 210.49 g and 17.28 t ha^{-1}) respectively (Table 2). Tuber grading at harvest also followed the same trend. This may be attributed to higher uptake of nutrients as a result of which the foliage cover was more and led to higher dry matter production per plant due to the added nutrients through foliar application of micro nutrients. And foliar application of micronutrients increases the physiological process and cell division and elongation which indirectly influence tissue formation and consequently vegetative growth of plant. Similar trend was observed by Sharma *et al.,* (2010).

Disease incidence

The late blight severity @ 60 DAP and 75 DAP and weight reduction in % 30 DAH of potato varied significantly due to application of various levels of calcium metalosate. The lower late blight incidence @ 60 DAP and 75 DAP and weight reduction in % 30 DAH (19.10%, 42.72% & 10.10%) were recorded with calcium metalosate @ 4 ml/l (T_5) which was on par with calcium metalosate @ 3 ml/l (20.10%, 42.52% & 10.18%), respectively and these parameters were lower with control (T_1, 24.12%, 54.85% & 13.02%) respectively (Table 3). This might be due to supplied calcium enhanced the cell division and cell elongation which reduced the late blight disease incidence.

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