

# Formulation of a Fertilizer Package for Hybrid Varieties of Pumpkin (*Cucurbita maxima*)

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## ABSTRACT

Introduced hybrid pumpkin (*Cucurbita maxima*) varieties are becoming popular in Sri Lanka because of the higher yield. However, there is no fertilizer recommendation for hybrid pumpkin. Local farmers apply high dosages of Nitrogen (N), Phosphorus (P) and Potassium (K) levels which causes increased cost of production and reduced profit. Therefore, a field experiment was conducted to identify the effects of higher N, P and K levels on yield of hybrid pumpkin. The hybrid variety Arjuna was tested under eight different fertilizer levels where the Department of Agriculture (DOA) recommendation was taken as the control and one and half times of that was used as the higher levels of N, P and K. The experiment was arranged in a confounding design with three replicates with two blocks per each. Reproductive parameters and yield parameters *viz.* yield, number of fruits per vine, fruit width and diameter were recorded. The tested fertilizer levels did not show any significant effect on reproductive parameters and yield parameters of hybrid pumpkin, thus, indicating that the application of higher dosages of N, P and K is not economical. Hence, the DOA fertilizer recommendation is adequate for hybrid pumpkins as well though the yield is higher when compared to local pumpkin varieties.

**KEYWORDS:** Fertilizer, Hybrid pumpkin, N P K levels, Yield

## INTRODUCTION

Pumpkin (*Cucurbita maxima*) is a popular market vegetable in the tropics and is grown throughout the year. The pumpkin fruits are normally cooked, also the flowers and young leaves, particularly in Asia and West Africa (H.D Tindall, 1993). Pumpkins are also used for decorations. It is assumed to be a native of South America. Today *Cucurbita maxima* are cultivated world wide particularly in South America, India and Africa (Robinson and Decker-Walters, 1997).

Pumpkin belongs to family cucurbitaceae. The vegetables comprising pumpkins are made up of five species of the genus *cucurbita* namely, *C. pepo*, *C. maxima*, *C. moschata*, *C. mixta* and *C. ficifolia* (Ram, 1998). Pumpkin is an annual with a prostrate vining type of growth. In Sri Lanka. This crop can be grown during *maha* and *yala* seasons in dry and intermediate zones up to an elevation of about 500 m. A well drained soil containing organic matter is more suitable with a pH range of 5.5 - 7.5 (Anon, 2003).

The cultivated extent of pumpkin in Sri Lanka was 3742 ha in *maha* season and 2737 ha in *yala* 2004, with the production of 42715 mt in *maha* and 24 637 mt in *yala* (Anon, 2005). The cultivation, extent and production during *Maha* season were higher than that of *Yala* season probably due to the prevalence of favorable weather conditions during *Maha*. The major pumpkin growing areas in Sri Lanka are Mathale, Anuradhapura, and Batticaloa, Mahaweli system H, Kurunegala, Monaragala, Hambanthota, Rathnapura and Badulla. There is only one recommended pumpkin variety by the Department of Agriculture namely ANK Ruhunu, available in the country for cultivation.

However, farmers are willing to cultivate hybrid varieties mainly due to higher yield. There is no hybrid pumpkin variety that has been produced in Sri Lanka. However, in the absence of any restriction, hybrid pumpkin seeds are imported to Sri Lanka by several private companies. At present, 'Arjuna', an imported variety from India, is the most popular F<sub>1</sub> hybrid of pumpkin in the farmer fields and markets in Sri Lanka. It gives higher yield up to 4 fruits per plant with an average fruit weight of 3 to 3.5 kg. Arjuna is suitable for harvesting either as an immature green fruit or as a completely mature fruit, depending on the market requirements. Mature fruits have a shelf life of 4 to 6 weeks. It has firm, yellowish orange color flesh and excellent taste. Vines are vigorous and the variety has an intermediate resistance to viruses, downy mildew and powdery mildew (Anon, 2006).

However, farmers are unable to achieve the optimum profit by cultivating hybrid pumpkins mainly because of the incorrect fertilizer application. With the belief that hybrid pumpkins need higher amounts of fertilizers, farmers apply fertilizers in higher quantities but not in correct dosages. As a consequence, fertilizer toxicities, wastage of fertilizers and increased cost of production could be observed. This ultimately results reduced yield and profit. Therefore, the study was conducted with the objective to identify the effect of higher fertilizer levels on yield of hybrid pumpkin.

## MATERIALS AND METHODS

### 1. Experimental Site

The study was carried out at the Regional Agricultural Research and Development Center (RARDC), Makandura, situated in the low country

Intermediate zone at an elevation of 25 m above mean sea level. The major soil group is red yellow podsolic with hard and soft laterite (Panabokke, 1967). The soil can vary from sandy loam to sandy clay loam with moderately well drained. The experiment was conducted during the period from November 2005 to March 2006. The mean monthly weather data were recorded during the experimental period is shown in table 1.

**Table 1 - The mean monthly weather data recorded during the experimental period:**

Season <i>maha</i> 2005/2006 Month	Temperature (°C)		Rain fall (mm)	Relative humidity (%)
	Max.	Min		
November	31	23.22	327.5	87.23
December	30.83	22.47	85.9	86.27
January	31.7	21.6	141	88.03
February	33.6	22.6	25	86.7
March	32.41	22.32	153.7	86.95

Source: RARDC, Makandura

## 2. Treatments

Nitrogen (N), Phosphorus (P) and Potassium (K) were provided as Urea, Triple Super Phosphate (TSP) and Muriate of potash (MOP), respectively. Each nutrient was applied in two levels. Level 1 consisted of the Department of Agriculture (DOA) recommendation of N, P, K levels for pumpkin and the level 2 comprised one and half of that. Therefore, following eight treatments were tested in the field.

**Table 2 - Treatments used in the experiment:**

Treatment number	Combination
T <sub>1</sub>	N <sub>1</sub> P <sub>1</sub> K <sub>1</sub> (control)
T <sub>2</sub>	N <sub>1</sub> P <sub>1</sub> K <sub>2</sub>
T <sub>3</sub>	N <sub>1</sub> P <sub>2</sub> K <sub>1</sub>
T <sub>4</sub>	N <sub>1</sub> P <sub>2</sub> K <sub>2</sub>
T <sub>5</sub>	N <sub>2</sub> P <sub>1</sub> K <sub>1</sub>
T <sub>6</sub>	N <sub>2</sub> P <sub>1</sub> K <sub>2</sub>
T <sub>7</sub>	N <sub>2</sub> P <sub>2</sub> K <sub>1</sub>
T <sub>8</sub>	N <sub>2</sub> P <sub>2</sub> K <sub>2</sub>

**Table 3 - Fertilizer dosages used in the experiment:**

Time of application	DOA Recommended level (kg/ha)			One and half of DOA recommended Level (kg/ha)		
	Urea	TSP	MOP	Urea	TSP	MOP
Basal	75	200	60	112.5	300	90
4 weeks after planting	75	-	60	112.5	-	90
8 weeks after planting	75	-	60	112.5	-	90

**Table 4 - N, P, K levels used in the experiment:**

Level	Nitrogen (kg/ha)	P <sub>2</sub> O <sub>5</sub> (kg/ha)	K <sub>2</sub> O (kg/ha)
1 (DOA Recommendation)	35	92	36
2 (One and half of DOA)	52.5	138	54

## 3. Field Layout

Raised beds were arranged in 5 m x 5 m size and planting holes (30 cm x 30 cm x 30 cm) were prepared providing 2 m spacing. The treatments were arranged in a confounding design and replicated three times with two blocks per each replicate and four plots per each block.

## 4. Crop Establishment and Maintenance

Potted seedlings were planted in planting holes to maintain two vines per hill. Equal amounts of organic fertilizer (cattle manure) were added at the rate of ten tons per hectare and inorganic fertilizers were added according to the treatments. Overhead irrigation was done using a hand held hose and sprinklers. Irrigation methods and frequencies were adjusted according to the prevailed weather condition and the growth stage of the crop. Manual weeding was done until vines covered the ground.

## 5. Statistical Analysis

Data were recorded from each plot and the whole plot was considered in data recording due to practical reasons. The data generated from the experiment were statistically analyzed using Statistical Analysis System (SAS) statistical software packages.

## 6. Data Recording

### 6.1. Reproductive Parameters

Days to fifty percent flowering of staminate and pistillate flowers were determined by recording the number of days taken from the date of planting to 50% of vines had staminate and pistillate flowers in each plot.

### 6.2. Yield Parameters

The numbers of fruits per vine (kg), yield per vine (kg), marketable yield (mt) were determined in each plot.

### 6.3. Fruit Quality Parameters

Average fruit weight at the harvesting stage (kg), average fruit length from stem end to blossom end and average fruit diameter at the widest place (cm) were determined.

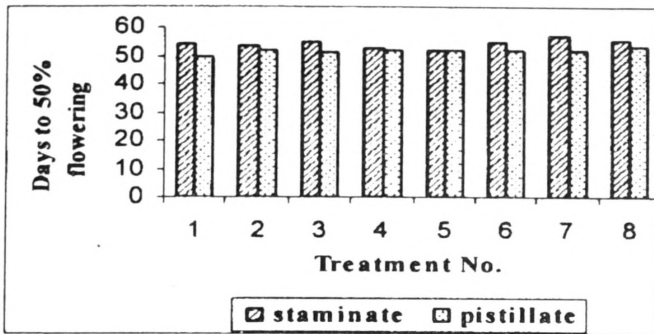
### 6.4. Pest and Diseases

Pests and diseases prevailed during the experimental period were observed and identified. The pest and disease management practices were carried out according to the DOA recommendations.

**RESULTS AND DISCUSSION**

**1. Reproductive Parameters**

The reproductive parameters recorded during the experimental period are shown in figure 1.



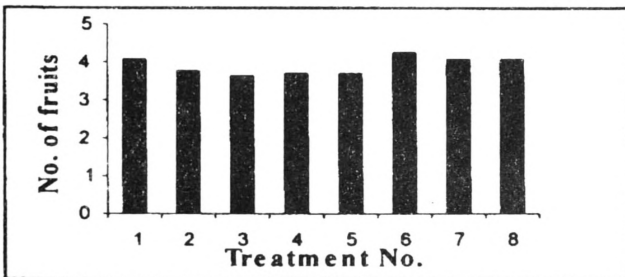
**Figure 1 - Days to 50% flowering of staminate and pistillate flowers:**

The number of days taken for 50 percent flowering in staminate and pistillate flowers was not significant among the treatments (Figure 1). However, the minimum numbers of days taken to 50 percent flowering for staminate and pistillate flowers were in T<sub>5</sub> and T<sub>2</sub> respectively. Staminate flowers completed 50 percent flowering earlier than pistillate flowers under all eight treatments.

**2. Yield and Fruit Quality Parameters**

**2.1 Number of Fruits per Vine**

Number of fruits per vine under eight treatments is shown in figure 2.



**Figure 2 - Average number of fruits per vine in hybrid pumpkin under different treatments:**

There were no significant differences in average number of fruits per vine among the plants grown under eight treatments (Figure 02). However, the number of fruits was highest in treatment number 6 which was having higher level of N, K and DOA recommended level of P.

**2.2 Total Yield, Marketable Yield and Yield per Vine**

The total yield, marketable yield and yield per vine did not differ significantly among the different fertilizer levels (Table 5). This indicates that the higher levels of fertilizer did not result higher yields than that of DOA recommendation. Though T<sub>8</sub> was one and half times higher N, P, K levels than the DOA recommendation it did not have impact on yield increase.

**2.3. Fruit Quality Parameters**

The table 5 depicts that, the average fruit weight, average fruit diameter and length were not significantly different among the eight fertilizer levels. Thus, the increased N, P, K levels could not result higher yields or improved fruit quality when compared to the DOA recommendation.

However, farmers are in the habit of applying higher N, P, K dosages for hybrid pumpkin with the objective of getting high yield and larger fruits. The results clearly show that it is not economical to go for fertilizer dosages which exceed the DOA recommended levels. Though the results were not significantly different, the highest yield could be observed in T<sub>6</sub> and there were no toxicity symptoms in pumpkin vines.

Similar results were obtained from Luffa (*Luffa acutangula*) and Bitter guard (*Momordica charantia*) which belongs to the same family. Studies have revealed that hybrid Luffa (Ariyaratna and Latheef, 2004) and hybrid Bitter guard (Pararajasingham, 2004) yields were not increased significantly with higher fertilizer levels. Previous research on hybrid Tomato (*Lycopersicum esculentum*) (Pieris., 2006) and hybrid Brinjal (*Solanum melongena*) (Fonseka,

**Table 5- Yield parameters and fruit quality parameters of hybrid pumpkin:**

Treatment No	Average Fruit length (cm)	Average Fruit diameter (cm)	Average fruit weight (kg)	Yield /vine (kg)	Marketable Yield (t/ha)	Total yield (t/ha)
N <sub>1</sub> P <sub>1</sub> K <sub>1</sub>	11.49 <sup>a</sup>	70.60 <sup>a</sup>	2.46 <sup>a</sup>	9.83 <sup>a</sup>	31.45 <sup>a</sup>	32.13 <sup>a</sup>
N <sub>1</sub> P <sub>1</sub> K <sub>2</sub>	10.95 <sup>a</sup>	71.13 <sup>a</sup>	2.45 <sup>a</sup>	9.09 <sup>a</sup>	29.10 <sup>a</sup>	29.75 <sup>a</sup>
N <sub>1</sub> P <sub>2</sub> K <sub>1</sub>	11.07 <sup>a</sup>	71.13 <sup>a</sup>	2.55 <sup>a</sup>	9.14 <sup>a</sup>	29.25 <sup>a</sup>	29.88 <sup>a</sup>
N <sub>1</sub> P <sub>2</sub> K <sub>2</sub>	11.13 <sup>a</sup>	68.13 <sup>a</sup>	2.35 <sup>a</sup>	8.76 <sup>a</sup>	28.04 <sup>a</sup>	28.59 <sup>a</sup>
N <sub>2</sub> P <sub>1</sub> K <sub>1</sub>	11.53 <sup>a</sup>	73.87 <sup>a</sup>	2.37 <sup>a</sup>	8.61 <sup>a</sup>	27.56 <sup>a</sup>	27.79 <sup>a</sup>
N <sub>2</sub> P <sub>1</sub> K <sub>2</sub>	11.46 <sup>a</sup>	70.67 <sup>a</sup>	2.38 <sup>a</sup>	10.10 <sup>a</sup>	32.31 <sup>a</sup>	32.74 <sup>a</sup>
N <sub>2</sub> P <sub>2</sub> K <sub>1</sub>	11.09 <sup>a</sup>	66.05 <sup>a</sup>	2.18 <sup>a</sup>	8.88 <sup>a</sup>	28.44 <sup>a</sup>	29.71 <sup>a</sup>
N <sub>2</sub> P <sub>2</sub> K <sub>2</sub>	11.75 <sup>a</sup>	69.80 <sup>a</sup>	2.33 <sup>a</sup>	9.46 <sup>a</sup>	30.27 <sup>a</sup>	30.87 <sup>a</sup>
CV	8.59	3.42	11.39	13.39	13.40	12.74

Means followed by the same letter in each column are not significantly different at p=0.05

2006) have also showed that significantly higher yields were not resulted with higher fertilizer levels.

### 3. Pest and Disease Occurrence

Damage of fruit fly (*Bactrocera cucurbitae*) was observed and it was minimized by spraying Fenthion. Aulacophora beetle (*Aulacophora foveicollis*) damage occurred in low severity. Diseases did not cause serious damages to crop during experimental period. Downy mildew and Cucumber mosaic virus could be observed only during the later stage of the crop. This may be due to the resistance of the variety Arjuna to those diseases.

### CONCLUSIONS

Application of higher dosages of NPK levels did not improve yield, fruit size or number of fruits in the hybrid pumpkin variety Arjuna. Therefore, it can be concluded that the DOA fertilizer recommendation for local pumpkin is adequate also for hybrid varieties. Application of higher dosages may not decrease the yield. However, this ultimately increases the cost of production, thus, reducing the profits. Previous studies have also shown (Wahundeniya, 2004) that, with the DOA recommended fertilizer levels, hybrid pumpkins performed better than the local varieties.

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