

1 **EFFECT OF NPK FERTILIZER ON FRUIT DEVELOPMENT OF PUMPKIN (*Cucurbita pepo***
2 **Linn.)**

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13 **ABSTRACT**

14 The effect of NPK fertilizer on pumpkin fruit development was studied for two cropping seasons in 2010 at
15 the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria in 2010. The experiment
16 was a randomized complete block design. The plants were treated with six NPK rates (0, 50, 100, 150,
17 200 and 250 kg/ha). Data on fruit weight, circumference, length and dry matter were obtained at 7, 14, 21
18 and 28 days after fruit formation. Increasing NPK fertilizer enhanced the parameters evaluated across the
19 sampling periods. Fresh fruit weight (g/fruit) in control was 39 g, 123 g, 822 g and 1059 g and this
20 increased to 80 g, 370 g, 1350 g and 1630 g at 7, 14, 21 and 28 days after fruit formation respectively at
21 100 kg NPK fertilizer rate. Across the NPK levels, pumpkin fruit growth curve was sigmoid. Excessive
22 NPK supply did not significantly increase the rate of fruit growth or the fruit size.

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24 *Keywords: Pumpkin; fruit development; NPK fertilizer; fruit weight; fruit dry matter*

1. INTRODUCTION

Cucurbita pepo Linn commonly known as pumpkin, zucchinis, squash or marrow, belongs to the Cucurbitaceae family. The family consists of two well defined subfamilies, eight tribes, about 118 genera and 825 species (Jeffrey, 1990). *Cucurbita* or yellow flowered cucurbit is considered to be one of the most morphologically variable genera in the entire plant kingdom. Cucurbits (Cucurbitaceae) are among the most important plant families supplying humans with edible products and useful fibers. Members of this family are very similar in above ground development, but they have high genetic diversity for fruit shape and other fruit characteristics, resulting in a variety of uses (Robinson *et al.*, 1976). *Cucurbita pepo* L. originated from North and Central Americas (Bisognin, 2002). Smith (1997) noted that one of the first species of *Cucurbita* to be domesticated in the New World was *C. pepo*.

Fertilizer affects the productivity of crops. Poor fruit setting, low crop yield and low nutritional quality result from inadequate levels of the primary nutrients namely: Nitrogen, Phosphorus and Potassium (Shukla *et al.*, 1980; Alwan, 1986; Martinetti and Paganini, 2006; Liu *et al.*, 2010). Application of N, P and K has been reported to increase the growth and productivity of pumpkin and crops generally (Al-Mukhtar *et al.*, 1987; Kumar *et al.*, 1995). Mobile phosphorus and potassium have also been reported by (MacCarthy *et al.*, 1990; Nurkoric *et al.*, 2004) to be very important for the setting, development and storage of pumpkin fruits. Adams (1986) reported that when P level is optimum, much of energy required for plant metabolism which is stored chemically in the form of complex organic phosphates adenosine triphosphate (ATP) will be made available and released as required. Therefore, important chemical processes involved in growth will be driven steadily. Aduayi *et al.*, (2002) reported that NPK is the three major fertilizer elements known to be deficient in most Nigerian soils due to intense pressure on land as a result of continuous cropping.

Though there has been some previous work on the effect of various factors on fruit size at harvest, little is known about their effect on fruit development. Hence, this study aimed at determining the influence of NPK fertilizer on the fruit development of Pumpkin.

2. MATERIALS AND METHODS

Field study was conducted at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria, for two seasons. The experiment was a randomized complete block design. NPK fertilizer 15:15:15 fertilizer rates were applied at 0, 50, 100, 150, 200, 250 kg/ha. The experiment was replicated six times. There were 6 plots per replication; each plot size was 10 m X 12 m and consisted 7 rows. Alley was 3 m, while the plants were spaced 2 m X 2 m. Land was ploughed twice and harrowed once before sowing. Two seeds per hole were sown and the seedlings were thinned to one plant per stand at 2 weeks after planting (WAP). The NPK fertilizer was added in two equal halves at 2 WAP and 6 WAP. Insecticide (lambda-cyhalothrin) was applied fortnightly from 6 to 10 weeks after planting. Post-emergence herbicide, glyphosate was applied at the rate of 200ml/15litre at 4 and 7 WAP for weed control.

Forty fruits of relative age and size were tagged at the onset of fruit set. From the tagged fruits, 5 developing fruits were harvested at 7, 14, 21, 28, days after fruit formation (DAFF). The following fruit development parameters were taken: fresh weight, dry weight, fruit length and fruit diameter.

All data were subjected to combined analysis of variance SAS (2003). Means squares, where significantly different, were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability. Regression analysis was performed for traits that had significant season and fertilizer mean squares.

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76 **3. RESULTS**

77 **3.1 Influence of NPK fertilizer on fruit development traits of pumpkin at 7 days after fruit** 78 **formation (DAFF)**

79 Table 1 showed that fruit development was enhanced with increasing fertilizer rates, however fresh fruit
80 weight, fruit dry matter, fruit length and fruit circumference from the application of 100 to 250 kg/ha were
81 similar and significantly better than control and 50 kg/ha NPK application rates. Mean fruit weight and dry
82 matter between 100-250 kg NPK was 80.6 g and 372 g respectively. The values were 36% to 52% and
83 43 to 56% respectively higher than fertilizer rates below 100 kg/ha. Figure 1 and 2 showed that fresh fruit
84 weight and fruit length were higher across the fertilizer levels in the early season than in the late season.
85 The response of fresh fruit weight fitted into quadratic equation with R^2 ranging from 0.91 to 0.95 while for
86 fruit length the range was 0.94 to 0.95. Fresh fruit weight generally increased from the control to reach the
87 optimum at 200 kg/ha of NPK fertilizer application. Optimal fresh fruit weight at 7 DAFF was 95 g/fruit and
88 70 g/fruit for early and late seasons respectively. Fruit length generally increased from the control to
89 reach the optimum yield at 100 to 250 kg/ha of NPK (15:15:15) fertilizer application. Optimal fruit length at
90 7 DAFF was 5.5 cm and 4.8 cm for early and late seasons respectively at 100 to 250 kg/ha of NPK.

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92 **3.2 Influence of season and NPK fertilizer on fruit development traits of pumpkin at 14** 93 **days after fruit formation (DAFF)**

94 Table 2 showed that fruit development traits increased with fertilizer rates, however fresh fruit weight, fruit
95 dry matter, fruit length and fruit circumference increased with fertilizer rates from the application at 100 to
96 250 kg/ha were similar and significantly better than control and 50 kg/ha NPK application. Figure 3
97 showed that fresh fruit weight was higher across the fertilizer levels in the early season than in the late
98 season. The response of fresh fruit weight fitted into quadratic equation with R^2 ranging 0.94 to 0.95.

99 Fresh fruit weight generally increased from the control to reach the optimum at 200 kg/ha of NPK fertilizer
 100 application. Optimal fresh fruit weight was 315 g/fruit and 460 g/fruit for late and early seasons

101 **Table1. Fruit development of Pumpkin as influenced by NPK fertilizer at 7 DAFF**

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NPK levels (kg/ha)	Fruit fresh weight (g)	Fruit dry matters (g)	Fruit length (cm)	Fruit circumference (cm)
control	38.5c	7.0c	2.7c	3.2c
50	51.9b	8.4b	3.7b	4.3b
100	80.6a	10.2a	5.2a	7.0a
150	80.3a	10.3a	5.0a	6.9a
200	81.4a	10.1a	5.1a	6.9a
250	80.0a	10.1a	5.1a	7.0a

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 104 Means with the same letter in each column are not significantly different at 5% level of
 105 Probability using Duncan's multiple range test.

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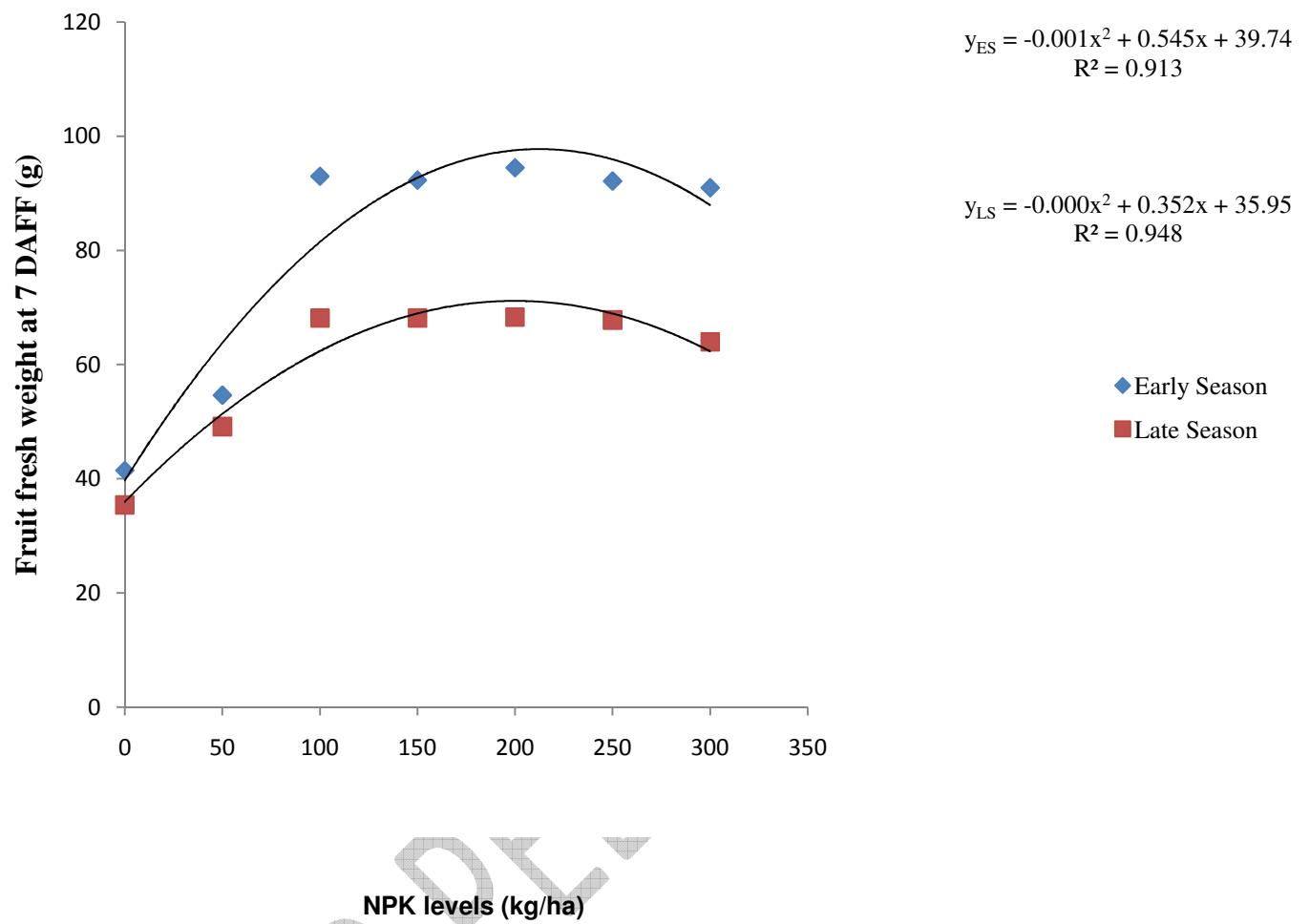


Fig. 1. Fruit fresh weight of pumpkin at 7 DAFF as affected by season by fertilizer

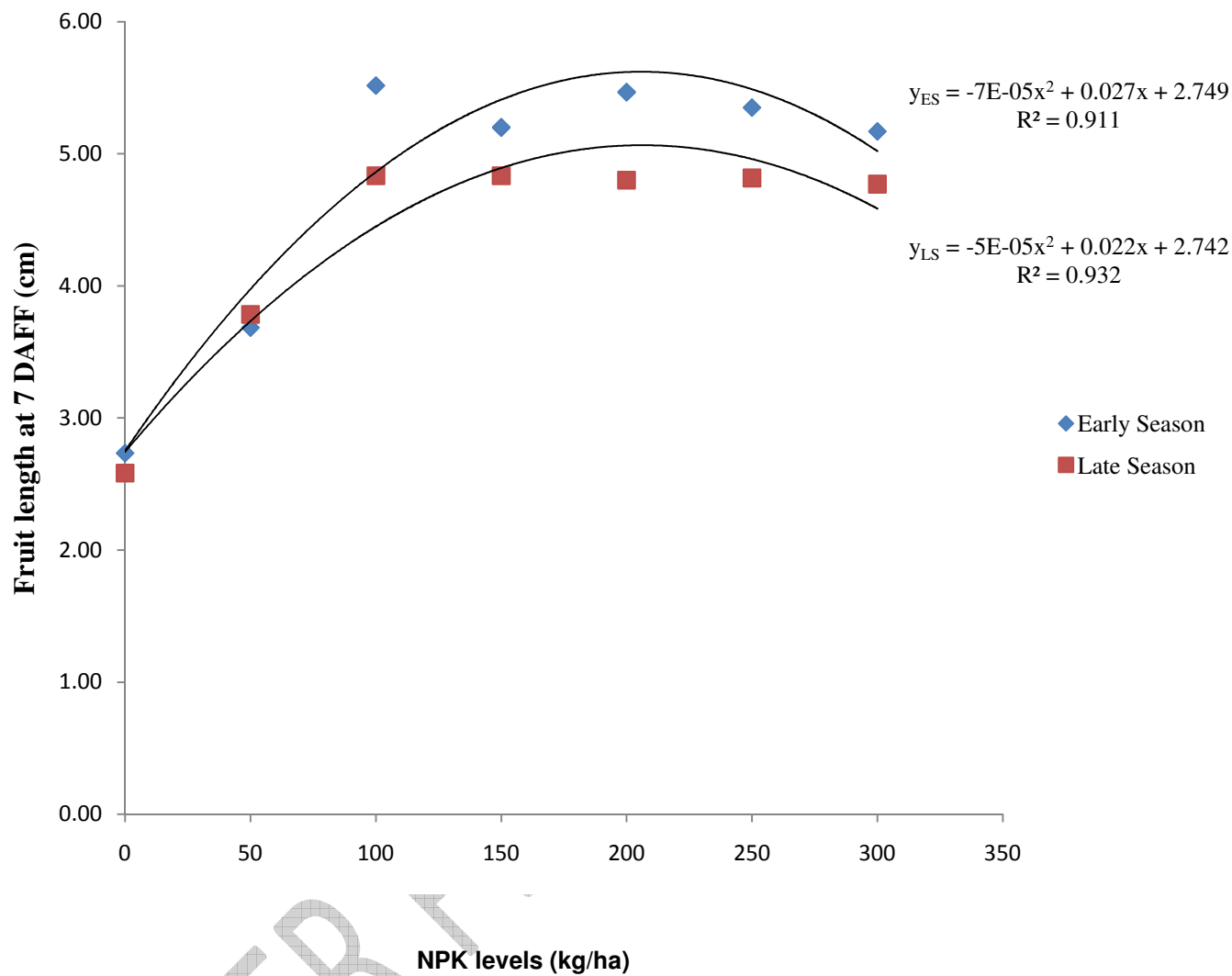


Fig. 2. Fruit length of pumpkin at 7 DAFB as affected by season by fertilizer

Table 2. Fruit development of Pumpkin as influenced by NPK fertilizer at 14 DAFF

NPK level (kg/ha)	Fruit fresh weight (g)	Fruit length (cm)	Fruit circumference (cm)	Fruit dry matters (g)
control	123.3c	6.9c	12.6c	27.4c
50	225.3b	8.2b	15.5b	35.7b
100	369.4a	9.7a	20.2a	61.8a
150	361.0a	9.8a	20.2a	61.4a
200	379.3a	9.7a	20.1a	63.4a
250	376.7a	9.7a	20.4a	62.2a

Means with the same letter in each column are not significantly different at 5% level of Probability using Duncan's multiple range test.

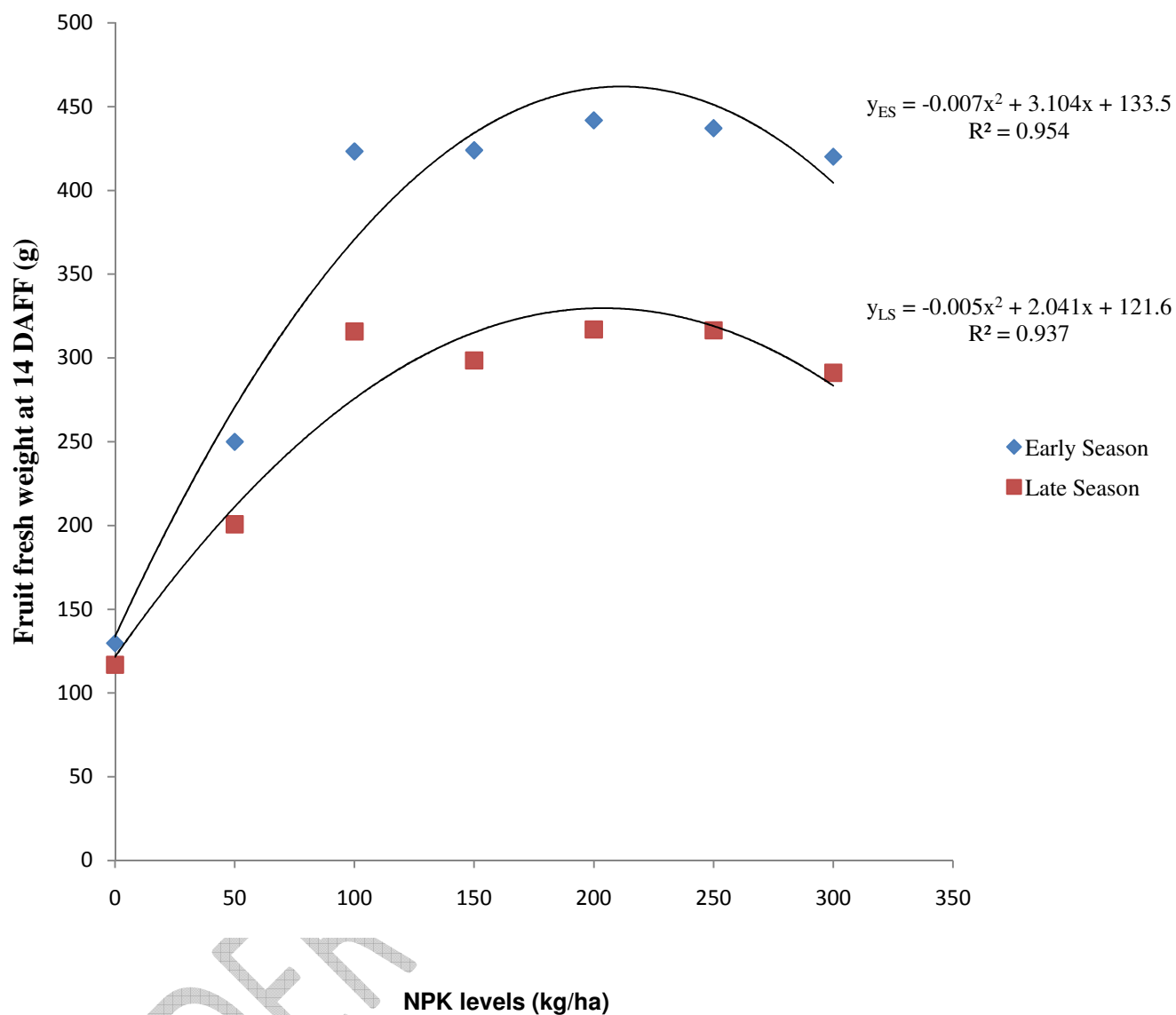


Fig. 3. Fruit fresh weight of pumpkin at 14 DAFF as affected by Season x fertilizer

respectively. Figure 4 showed that fruit length was higher across the fertilizer levels in the early season than in the late season.

The response of fruit length fitted into quadratic equation with R^2 ranging from 0.91 to 0.95. Fruit length generally increased from the control (zero fertilizer) to reach the optimum yield at 100 to 250 kg/ha of NPK (15:15:15) fertilizer application. At 14 DAFF, fruit length was 10 cm in the early season and about 9.5 cm in the late season. The fruit length in control ranges between 6.2-6.4 cm.

3.3 Influence of season and NPK fertilizer on fruit development traits of pumpkin at 21 days after fruit formation (DAFF)

Table 3 showed that fruit development traits increased with fertilizer rates, however fresh fruit weight, fruit dry matter, fruit length and fruit circumference increased with fertilizer rates from the application at 100 to 250 kg/ha were similar and significantly better than control and 50 kg/ha NPK application. Mean fruit weight and mean fruit dry matter between 100-250 kg NPK was 1351.7 g and 185 g respectively. Fruit fresh weight reduced at control and 50 kg NPK by 25% to 39% of the mean from 100-250 kg NPK while it was 29% to 39% for the fruit dry matter. The fruit length and fruit circumference were similar and better at 100 to 250 kg/ha and better than control and 50 kg/ha NPK application.

3.4 Influence of season and NPK fertilizer on fruit development traits of pumpkin at 28 days after fruit formation (DAFF)

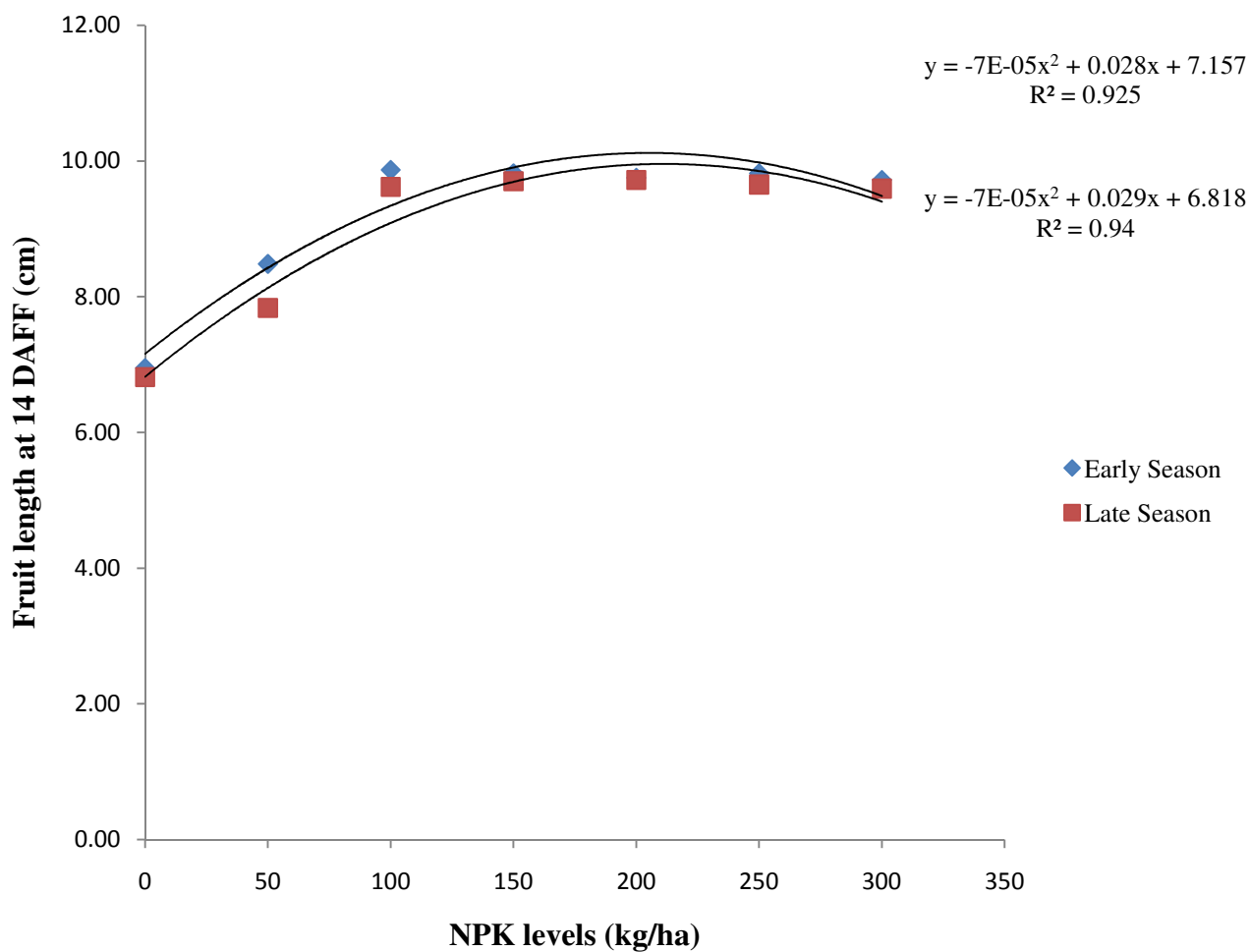
Table 4 showed that fruit development traits increased with fertilizer rates, however fresh fruit weight, fruit dry matter, fruit length and fruit circumference increased with fertilizer rates from the application at 100 to 250 kg/ha were similar and significantly better than control and 50 kg/ha NPK application. Mean fruit weight and mean fruit dry matter between 100-250 kg NPK was 1636 g and 432 g respectively. Mean fruit

fresh weight value of the mean from 100-250 kg NPK was 25% to 39% higher compared to the control and 50 kg/ha NPK application. The mean value for fruit dry matter reduced by 30 to 45% at control and 50 kg/ha NPK application. The fruit length and fruit circumference were similar and better at 100 to 250 kg/ha than control and 50 kg/ha NPK application. The response of fruit fresh weight at 28 DAFF fitted into quadratic equation with R^2 ranging from 0.91 to 0.95. Fruit weight was 1755 g/fruit for the early season. The fruit weight was lower in late season with 1450 g/fruit (Figure 5).

4. DISCUSSION

In this study, fruit development was enhanced by NPK fertilizer across the sampling periods. The dependence of fruits weight on fertility and season in Cucurbits had earlier been reported (Oloyede and Adebooye, 2005; Konovo and Rainova 1981). The optimum NPK level in this study was 100 kg/ha where the fruit fresh weight, fruit circumference, fruit length and dry matter were higher than all other lower NPK levels and did not significantly differ from higher NPK levels. Fruit number and fruit weight of pumpkin have been reported to be depressed in Lithuania due to increased fertilizer (Al-Mukhtar *et al.*, 1987; Martinetti and Paganini, 2006).

As observed in this study, at the onset of fruit set, fruit growth was very slow. At the 21st day after fruit formation, the growth reached its peak after which it started to decline. This corroborates past findings by MacArthur and Wetmore (1941); Smith (1950) in apples; Nitsch *et al.* (1960) in grapes who reported that at full bloom, fruit let growth is slow, or cease for a few days. The duration of this preliminary period of slow growth varies from season to season Denne, 1960); this may be related to the interval between pollination and fertilisation, though fertilisation is reported to occur before the end of this period in the grape (Nitsch *et al.*, 1960). The time from pollination to fertilisation appears to be very variable; in the apple it has been shown to take from 48 hours (Modlibowska, 1945) to 12 days (Wanscher, 1939). After fertilisation there is a phase of rapid growth, which is exponential at first in cucurbits (Sinnott, 1945), and apples (Denne, 1960). Subsequently, the rate of growth may decline until harvest, giving a simple sigmoid type of growth curve, or there may be a period of little or no expansion between the rapid enlargement



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189 Fig. 4. Fruit length of pumpkin at 14 DAFF as affected by Season x fertilizer.

190 Table 3. Fruit development of Pumpkin as influenced by NPK fertilizer at 21 DAFF

NPK level (kg/ha)	Fruit fresh weight (g)	Fruit length (cm)	Fruit circumference (cm)	Fruit dry matters (g)
control	821.5c	10.9c	22.4c	112.2c
50	1014.5b	13.0b	27.1b	130.8b
100	1353.4a	15.1a	33.4a	184.7a

150	1351.7a	15.2a	33.3a	185.4a
200	1356.9a	15.1a	33.5a	184.2a
250	1344.8a	15.0a	33.3a	185.2a

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192 Means with the same letter in each column are not significantly different at 5% level of Probability using
 193 Duncan's multiple range test.

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Table 4. Fruit development of Pumpkin as influenced by NPK fertilizer at 28 DAFF

NPK level (kg/ha)	Fruit fresh weight (g)	Fruit length (cm)	Fruit circumference (cm)	Fruit dry matters (g)	Fruit growth rate (g/day)	Fruit growth duration (day)
control	1058.5c	13.98c	38.0c	238.9c	11.0c	22.5a
50	1273.3b	15.09b	44.2b	303.0b	14.0b	22.3a
100	1621.9a	17.21a	52.4a	429.0a	19.9a	22.0a
150	1653.0a	17.33a	52.5a	428.5a	19.9a	22.0a
200	1623.0a	17.22a	52.5a	434.7a	20.2a	22.0a
250	1644.6a	17.11a	52.6a	435.7a	20.3a	22.0a

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Means with the same letter in each column are not significantly different at 5% level of

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Probability using Duncan's multiple range test.

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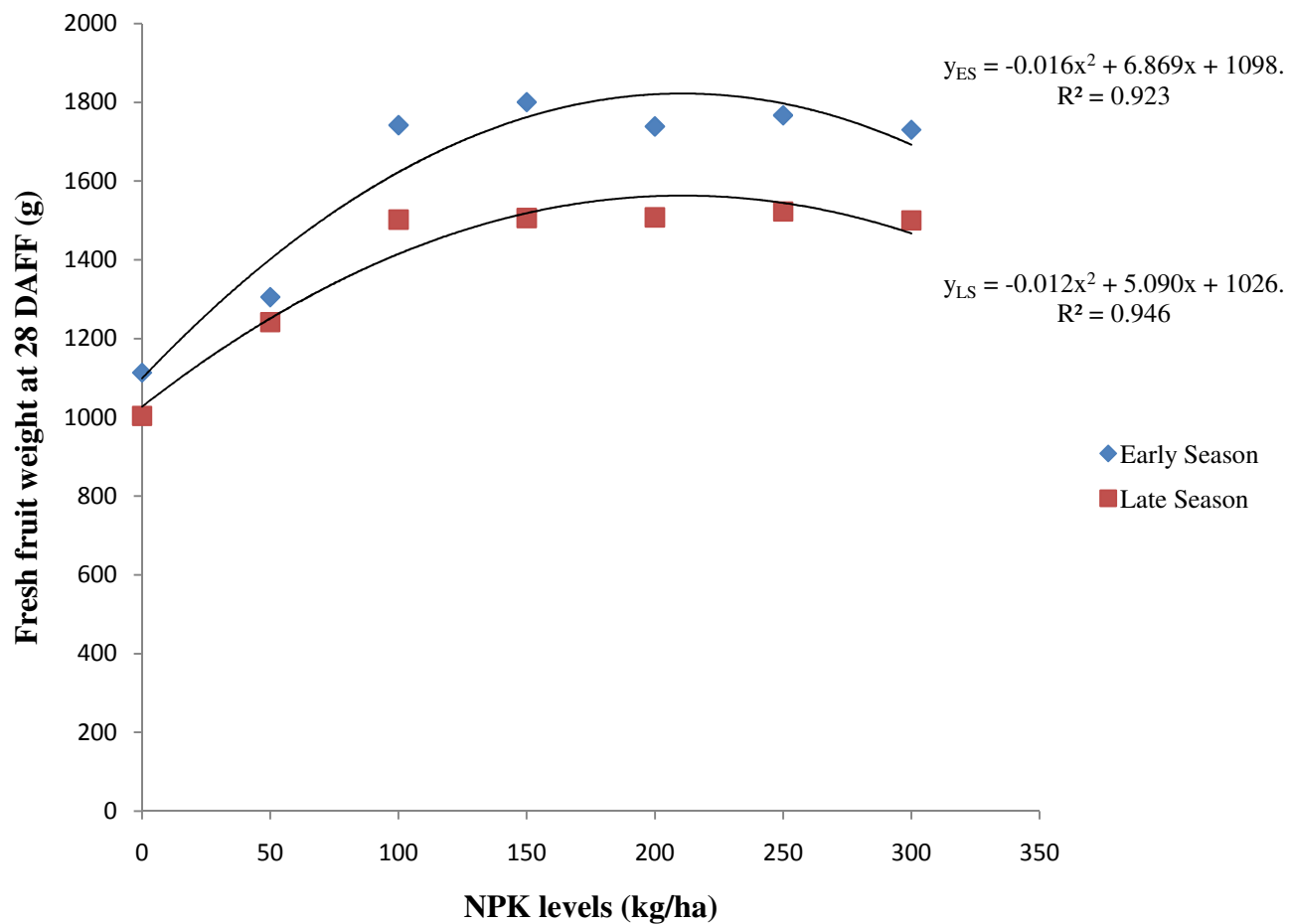


Fig. 5. Fresh fruit weight of pumpkin at 28 DAFF as affected by Season x fertilizer

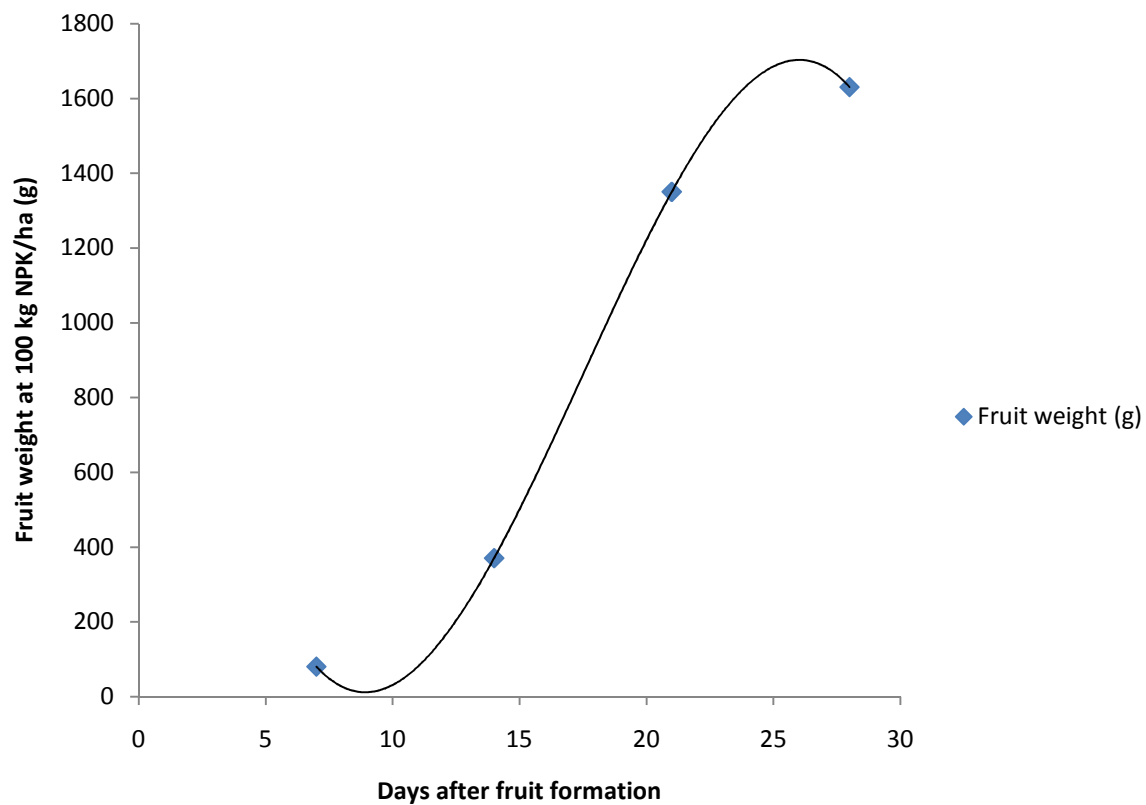


Fig. 6. Pumpkin fruit growth curve at 100 kg/ha NPK fertilizer level

after fertilization and the final swelling. The simple sigmoid type of growth curve is characteristic of cucurbits and tomatoes (Gustafson, 1926).

5. CONCLUSION

NPK fertilizer influenced pumpkin fruit growth positively, however, beyond 100 kg/ha, NPK fertilizer supply did not significantly increase the rate of fruit growth or the fruit size.

COMPETING INTEREST

No competing interest exists.

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