



GROWTH AND YIELD EVALUATION OF SOME HOT PEPPER (*Capsicum annum* L.) VARIETIES IN UMUDIKE, NIGERIA

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ABSTRACT: A field experiment was conducted at the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike, during 2024 and 2025 cropping to evaluate some hot pepper varieties. The treatments were laid in a randomized complete block design (RCBD) with three replications. The plot size was 2.0m x 3.0 m (6m²). Sowing of seed at nursery took place in March while the seedlings were transplanted into the field at two months after sowing. The data collected were subjected to analysis of variance (ANOVA). The treatment means were separated using least significant difference at 5% probability level and Pearson Correlation coefficient were used to compare association of characters. The results from the analysis of variance revealed that the number of branches, plant height, number of days to first flowering, number of days to 50% flowering, number of flowers per plant and fruit yield characteristics of pepper varieties were significantly ($P \leq 0.05$) affected by variety. The variety Shombor produced highest plant height (101.20 cm). The earliest to flower was Star pepper that flowered at 51.3 days after transplanting (DAT), followed by Shombor that flowered after 56.0 DAT. The variety with the longest fruit was Shombor (8.1cm), followed by Atarodo (7.1cm). Shombor also produced the highest number of fruits per plant (219.6), while the least number of fruits per plant was obtained from Effia (9.8). Shombor produced the highest fruit yield per hectare (8407.0 kg/ha). This was followed by Star pepper that had fruit yield per hectare of 5624.4kg/ha. Atarodo and Effia had the least fruit yield per hectare with the values of 558.1 and 944.4 kg/ha, respectively. Result from correlogram showed that highly significant and positive correlation was observed between fruit yield per hectare and number of branches ($r = 0.76^{**}$), number of leaves ($r = 0.82^{***}$), weight per fruit ($r = 0.74^{**}$) and fruit length ($r = 0.73^{**}$) and significant negative correlation with number of days to 50% flowering ($r = -0.71^{**}$), number of days to fruiting ($r = -0.73^{**}$) and days to 50 % ripening ($r = -0.62^{*}$). A highly significant and positive correlation was observed between plant height and fruit yield per hectare ($r = 0.85^{***}$), number of branches ($r = 0.86^{***}$), number of leaves ($r = 0.87^{***}$) and weight per fruit ($r = 0.72^{**}$).

Keywords: hot pepper, pepper varieties, yield, Correlogram, growth

INTRODUCTION

Hot pepper (*Capsicum annum* L.) belongs to the family Solanaceae (Onwubuya *et al.*, 2009). It originated in the Mexico and Central American regions (Purseglove, 1991) and regarded as the

worlds' second most important vegetable after tomato (Bosland and Votava, 2000). Apart from being used as a seasoning to cooked food, capsicum plays a vital role in the nutritional balance by supplying vitamins and minerals in human diets. Pepper is an excellent source of natural antioxidants (carotenoids), Vitamins (A, C and E) and micronutrients (Iron) which are critically important in preventing/treating chronic and age related diseases (Namiki, 1990). It is grown primarily for its pungency due to high content of

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capsaicin (Bosland and Votava, 2000). Moreover, pepper is used as a spice in many dishes, as decoration in food, adds flavor and colour, provides relief for several ailments, reduces muscle pain, act as a heart stimulant which regulates blood flow and strengthens the arteries. Nigeria is one of the major peppers producing countries in the world accounting for about 50% of Africa's production (FAOSTAT, 2020). Although pepper is grown in many parts of the country, the major area for its production is the northern region between Latitude 10°N and 12°30'N (Adetula and Olakojo, 2006). In the South eastern Nigeria, the yield of pepper is relatively low (6.78 – 14 t/ha). However, according to Grubben and El Tahir (2004) hot pepper has the potential to yield up to 18 t/ha and sweet pepper up to 30 t/ha in open-fields as reported in Mali (AVRDC/Mali;2008). This indicates that there is high need for further improvement of pepper yield in South-eastern Nigeria (MARC, 2005). Among major challenges to enhanced levels of hot pepper productivity are shortages of improved varieties. Yield is dependent on the genetic background of the plant and the environment, therefore focus should be on varieties with high yielding potential and moderate to high tolerance to the prevailing biotic and abiotic environmental conditions in which they are grown. In Nigeria, the production of exotic vegetables is increasingly becoming a livelihood strategy as unemployment level reaches 30% FAOSTAT (2020). Pepper, which is one of such vegetables can contribute significantly to the country's economy with production dominated by women. As stated earlier, improved high-yielding hot pepper varieties are scarce, in Nigeria, particularly in the study area. To overcome this challenge, a viable strategy is the introduction of improved high-performing varieties from regional and national research centers (Alemu and Ermias, 2020). Therefore, this study was carried out to evaluate the performance of different varieties of hot pepper for growth and fruit yield under Umudike condition and to determine the relationship among variables of the studied pepper.

MATERIALS AND METHODS

Experimental location: The study was conducted at the Research Farm of the Michael Okpara University of Agriculture Umudike, during the 2024 and 2025 cropping seasons. Umudike is located at Longitude 07°33' E, Latitude 05°29' N of the equator with an elevation of 122 m above sea level (Agugo and

Opara, 2008). Umudike is a rain forest vegetation with relative humidity of 50 – 95 % and a bimodal rainfall pattern (NRCRI, 2007). The soil of the experimental site is classified as Sandy Loam Ultisol (Njoku *et al.*, 2009).

Land Preparation: The experimental site was mechanically slashed, ploughed, harrowed and ridged. The site was then marked out using a measuring tape, pegs and rope. The total land area for the experiment was 10 m x 19 m (190 m²) which was further divided into 15 plots of 2.0 m x 3.0 m (6 m²) with 1 m and 0.5 m spacing between blocks and plots respectively.

Treatment and Experimental Design: Five hot pepper varieties were purchased from reputable seed dealer in Abia and Imo State. Seeds of these genotypes was germinated and raised in nursery for 60 days, and then transplanted in the field, 8 plants per variety. Before germinating, seeds were treated with fungicide as seed dressing chemicals. The five varieties were laid out in a randomized complete randomized design with three replications. The plant spacing was 75cm x 100cm, giving 8 plants per plot.

Cultural practices: Agronomic practices (cultivation, weeding and fertilization) were applied uniformly for all plots. Pepper seedlings were transplanted at the onset of the rainy season; a basal application of NPK fertilizer (15:15:15) was applied at a rate of 300 kg/ha to all plots; weeding was carried out manually at three-week intervals while integrated pest management practices was employed to control pests and diseases.

Data collection

Data were collected from the middle six plants from central rows excluding the border rows and the rest of all response variables were recorded from the average of those six selected sample plants per plot.

Statistical Analysis

Excel 2010 was used to process the experimental data, while RStudio 12.0 and Genstat Discovery 12th Edition (Genstat, 2007) were used to perform the analyses. The treatment means were compared using the least significant difference (LSD) at ($p < 0.01$) and ($p < 0.05$) probability level of significance (Gomez and Gomez, 1984). For two years, the experiment was conducted in the same place. To find out if there were any significant differences across the

years for the different examined traits, a combined analysis of variance (ANOVA) was carried out. The data for the two years were pooled as there were no significant differences between years. Yield was presented in boxplot which was constructed in the statistical software RStudio version 12.0 using ggplot2 package (R Core Team, 2022). The R program was also used to generate a correlogram which shows correlation matrix between the various phenotypic traits, and the findings were shown as a heatmap.

RESULTS

Results and discussion

Results: Results from the analysis of variance (ANOVA) presented in Table 1 revealed that the number of leaves of pepper was significantly ($P \leq 0.05$) affected by the variety. With respect to number of leaves, Shombor pepper variety had the highest number of leaves with the value of 101.2. Followed by Star pepper and Nsukka yellow pepper that had 97.9 and 64.4 leaves, respectively. The smallest number of leaves was obtained from Atarodo (41.4). The plant height varied significantly ($p < 0.05$) with the variety. Means results show that Shombor variety was the tallest plants with the value of 70.6 cm. This was followed by Star pepper that had the value of 55.9 cm. The shortest plant was recorded from Atarodo variety with the values of 24.2 cm (Table 1). The mean highest number of branches was recorded in Shombor variety with the value of 24.7. This was followed by Star pepper and Nsukka yellow pepper varieties that had 22.6 and 14.3 branches. The variety with the smallest number of branches was Atarodo which had the value of 6.7 branches. Number of days to 50% flowering and number of flowers per plant of pepper varieties were significantly ($P \leq 0.05$) affected by the variety. With respect to number of days to flowering, the earliest to flower was Star pepper variety that flowered after 51.3 days after transplanting. This was followed by Shombor and Nsukka yellow pepper that flowered after 56.0 and 59.3 days after transplanting, respectively. With respect to number of days to 50% flowering, the variety that attained earliest 50% flowering was Star pepper variety that reached 50% flowering at 58.7 days after transplanting. With respect to number of flowers per plant, the variety with the highest number of flower per plant is Star pepper variety that had

373.3 flowers per plant. This was followed by Shombor that had 223.3 flowers. The results from the analysis of variance presented in Table 1 revealed that the number of days to 50% fruiting and number of days to 50% ripening of pepper varieties were significantly ($P \leq 0.05$) affected by variety. The mean result from number of days to 50% fruiting showed that the variety that attained earliest 50% fruiting is Star pepper on the 79.3 days after transplanting. This was followed by Nsukka yellow pepper and Shombor that reached 50% fruiting at 85.7 and 90.0 days after transplanting, respectively. Star pepper attained earliest 50% ripening (100.7 days after transplanting). Fruit length and fruit girth of pepper varieties were significantly ($P \leq 0.05$) affected by the variety. With respect to fruit length, the mean result showed that the variety with the longest fruit was Shombor variety (8.1cm). This was followed by Atarodo and Star pepper that had fruit length of 7.1 and 6.8 cm, respectively. Nsukka yellow pepper had the shortest fruit (5.3 cm). Result from the fruit girth showed that the variety with the highest fruit girth was Effia (2.8 cm). This was followed by Nsukka yellow pepper and Atarodo that had fruit girth of 2.3 and 2.8 cm, respectively. Pepper yield attributes namely, number of fruits per plant, weight per fruit (g), fruit yield per plant (g) and fruit yield per hectare (kg/ha), responded significantly to variety. Shombor variety produced the highest number of fruits per plant (219.6), followed by Star pepper variety (131.7). While in weight per fruit, Shombor and Star pepper had the highest weight per fruit with the value of 9.3 and 8.3 g, respectively. With respect to fruit yield per plant and fruit yield per hectare, Shombor produced the highest fruit yield per plant and fruit yield per hectare with the values of 951.1 g and 8407.0 kg/ha, respectively. This was followed by Star pepper that had fruit yield per plant and fruit yield per hectare of 597.5 g and 5624.4kg/ha, respectively. Atarodo and Effia had the least fruit yield per hectare with the values of 558.1 and 944.4 kg/ha, respectively (Table 1 and figure 1).

Table 1: Mean agronomic and yield traits variations of 5 pepper varieties evaluated 2024 and 2025 in Umudike

VARIETY	No. of Leaves per plant	Plant height (cm)	Number of branches	Number of days to flowering	Number of days to 50% flowering	Number of flowers per plant	Number of days to 50% fruiting	Number of days to 50% ripening	Fruit length (cm)	Fruit girth (cm)	Number of fruits per plant	Weight per fruit (g)	Fruit yield per plant (g)	Fruit yield per hectare (kg/ha)
Effia	51.1	36.4	9.3	81.3	88.3	10.9	98.3	117.0	6.0	2.8	9.8	4.3	170.0	944.40
Nsukka yellow pepper	64.4	32.0	14.3	59.3	64.3	20.1	85.7	103.7	5.3	2.3	19.8	5.8	154.7	1811.00
Atarodo	41.4	24.2	6.7	93.7	100.0	13.4	101.3	130.0	7.1	2.2	12.1	5.3	166.0	558.10
Shombor	101.2	70.6	24.7	56.0	62.0	223.8	90.0	104.7	8.1	2.0	219.6	9.3	951.1	8407.00
Star pepper	97.9	55.9	22.6	51.3	58.7	373.3	79.3	100.7	6.8	2.1	131.7	8.3	597.5	5624.40
MEAN	71.2	43.8	15.5	68.3	74.7	128.3	90.9	111.2	6.7	2.3	78.6	6.6	407.9	3469.00
LSD _(0.05)	37.9	25.8	12.2	15.7	15.0	216.0	12.6	16.8	0.7	0.4	127.9	1.6	348.1	1962.80

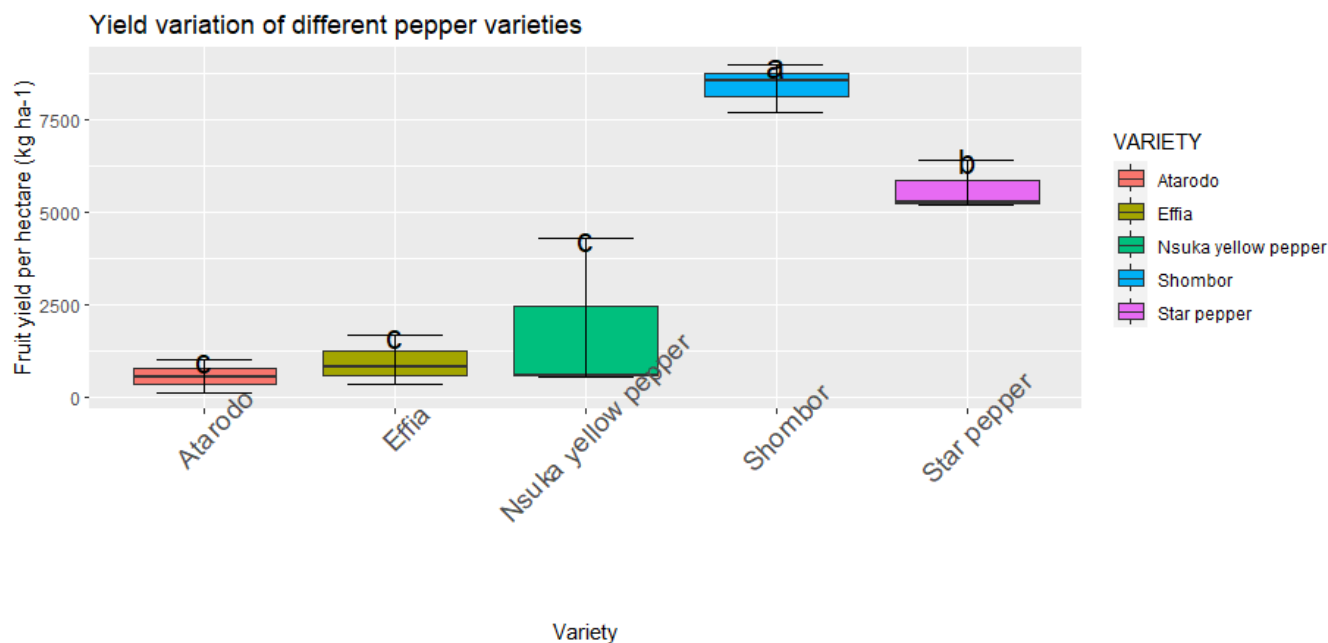


Fig. 1.

Boxplot showing mean yield variation of pepper varieties evaluated in 2024 and 2025 in Umudike

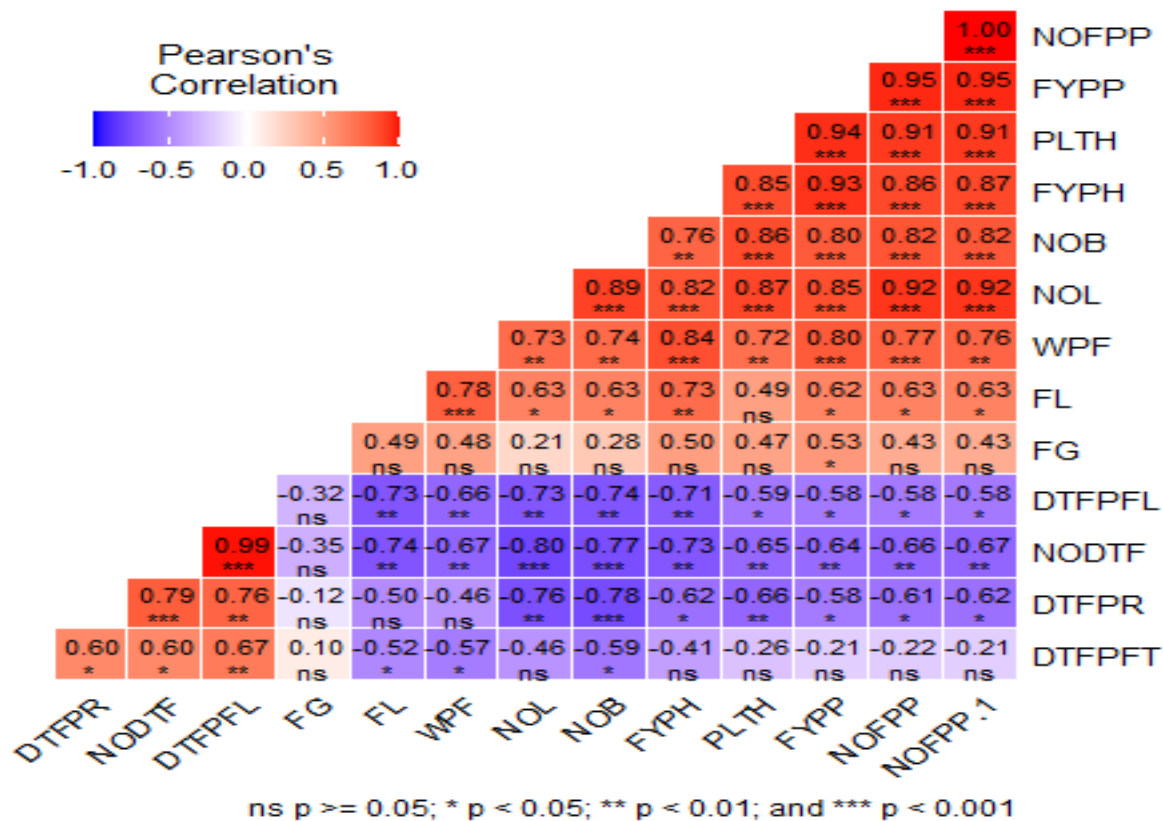


Fig. 2. Correlogram (Correlation matrix) of the 14 morphological traits of some pepper varieties evaluated. Negative correlations are shown in blue, while positive correlations are shown in red. The correlation coefficient determines how intense the color is, therefore the closer the correlation is to -1 or 1, the darker the boxes will be. DTFPR = days to 50 % ripening, NODTF = number of days to fruiting, DTFPFL = number of days to 50% flowering, FG = fruit girth, FL = fruit length (cm), WPF= weight per fruit(g), NOL = number of leaves per plant, NOB = number of branches per plant, FYPH = fruit yield per hectare (kg/ha), PLTH = plant height(cm), FYPP = fruit yield per plant (g), NOFPP = number of fruits per plant, NOFPP 1 = number of flowers per plant, DTFPFT = number of days to 50% fruiting.

Correlogram analysis and correlation coefficient

Pearson correlation coefficients among 14 studied traits in the current study are shown in Fig. 2. The correlogram displays the correlations between each pair of variables. Positive and negative correlations are denoted by red and blue colours, respectively. Darker boxes indicate high correlations as the correlation coefficient is proportional to colour intensity. From the result, number of flowers per plant showed highly significant positive correlation with number of fruits per plant ($r = 1.00^{***}$), fruit yield per plant ($r = 0.95^{***}$), plant height ($r = 0.91^{***}$), fruit yield per hectare ($r = 0.87^{***}$), number of branches per plant ($r = 0.82^{***}$), number of leaves per plant ($r = 0.92^{***}$), weight per fruit ($r = 0.76^{**}$) and fruit length ($r = 0.63^{*}$). While significant negative correlation was observed between number of flowers per plant and number of days to 50% flowering ($r = -0.58^{*}$), number of days to fruiting ($r = -0.67^{*}$), days to 50 % ripening ($r = -0.62^{*}$). A highly significant and positive correlation was observed between fruit yield per hectare and number of branches ($r = 0.76^{**}$), number of leaves ($r = 0.82^{***}$), weight per fruit ($r = 0.74^{**}$) and fruit length ($r = 0.73^{**}$) and significant negative correlation with number of days to 50% flowering ($r = -0.71^{**}$), number of days to fruiting ($r = -0.73^{**}$) and days to 50 % ripening ($r = -0.62^{*}$), and non-significant negative correlation with number of days to 50% fruiting ($r = -0.41$). A highly significant and positive correlation was observed between plant height and fruit yield per hectare ($r = 0.85^{***}$), number of branches ($r = 0.86^{***}$), number of leaves ($r = 0.87^{***}$) and weight per fruit ($r = 0.72^{**}$). However, significant negative correlation between plant height and number of days to 50% flowering ($r = -0.59^{**}$), number of days to fruiting ($r = -0.65^{**}$) and days to 50 % ripening ($r = -0.66^{*}$).

DISCUSSION

The differences observed among evaluated pepper varieties with respect to growth parameters including; plant height, number of leaves and number of branches could be ascribed to genetics differences among pepper varieties evaluated. This is because variability that exists among the crop varieties are mainly due to genetic influence. This is in line with the findings of Del *et al.* (2007) who reported that, the variation observed in pepper genotypes may be mainly due to the genetic difference among different plants. The result is also in conformity with Khan *et*

al. (2019) who reported similar results for the above parameters when two local varieties of pepper were evaluated for growth and yield. They attributed the significant differences for plant height and number of leaves to genetic differences. Moreover, result further corroborates with the findings of Abd El-Aziz (2007). Earliness or lateness in the number of days to flowering and number of days to 50% flowering might have been due to their inherited characters and early acclimatization to the growing area to enhance their growth and developments. This result, therefore confirmed the findings of Sam-Aggrey *et al.* (2005) that reported earliness or tardiness in flowering of pepper plants could be affected by the genetic make-up of the variety. These variations in number of flowers per plant between varieties might be due to their inherited traits. However, Durner *et al.*, (2002), reported that the primary cause of poor flowering, variation in number of flowering and fruit set could be due to diseases, wind and heavy rain during flowering. Sreelanthakumary and Rajamony (2004), reported that the inhibitory effect of high temperature can affect number of flowers per plant. The recorded variations among the pepper varieties with respect to yield parameters such as fruit length, fruit girth, number of fruits per plant, weight per fruit, fruit yield per plant and fruit yield per hectare could be due to their differences in genetic make-up. This result is in line with MARC (2005) which showed that fruit length and fruit girth vary with variety. According to the authors, the fruit girth difference among varieties could be due to different dry matter partitioning ability of plants. This result is generally similar to the findings of Dagnoko *et al.*, (2013) who stated that yield differences in crop cultivars may be attributed to plant stomata ability in the allocation of photosynthetic material to economic yield. Maga *et al.* (2012) suggested that increase in yield characteristic of a variety over another may be due to differences in adaptation to environmental conditions. Similarly, Omiat *et al.* (2005), indicated that the varietal effect had a significant influence on fruit yield of pepper. The significant and positive correlation was observed between number of leaves and number of branches, number of flower per plant, fruit length, weight per fruit, fruit yield per plant and fruit yield per hectare. This indicated that as the number of leaves increases, number of flower per plant, fruit length, weight per fruit, fruit yield per plant and fruit yield per hectare of pepper also increases. Similarly, as the plants increased in height,

number of branches, number of flower per plant, fruit length and weight per fruit, fruit yield per hectare of pepper increases. Number of fruits per plant, Plant height, fruit yield per plant, weight per fruit and number of branches were all positively related to fruit yield, and hence, simultaneous selection for these traits may increase fruit yield output. Similar findings were made by Prakash *et al.* (2006) and Bartaula *et al.* (2019) who reported that if there is a positive and significant relationship between these traits, the selection for those attributes would imply an indirect selection of variety for high yield. According to Kharel *et al.* (2017), a significant and positive correlation between yield and attributes that contribute to yield is helpful in direct selection for boosting fruit yield.

Conclusion: The study was carried out using five (5) different varieties of hot pepper in Umudike in 2024 and 2025 cropping season. The experiment revealed enough genetic variability among the studied five pepper varieties. Among, the five different varieties of evaluated, Shombor and Star pepper were found

good for Umudike and its environs. Traits such as number of branches, plant height, weight per fruit, fruit yield per plant and fruit length were among the most important yield components which had highly significant positive correlation with fruit yield per hectare. Thus, selection based on these traits could improve fruit yield per hectare.

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Conflicts of Interest: The authors declare that they have no conflict of interest.

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