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Correlation Association in Litchi (*Litchi chinensis* Sonn.) for Panicle, Fruit Set and Quality Attributes

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ABSTRACT: Litchi bears fruits on panicle and its characteristics significantly affect fruit set and quality of fruits. Weak panicle exhibits very poor fruit set and quality which is one of the major challenges. Therefore, an experiment was conducted to assess the relationship among panicle, fruit set and quality of litchi in 2017 and 2018 at ICAR-National Research Centre on Litchi, Muzaffarpur, Bihar. Ten years old cultivars of litchi Mandaraji, Rose Scented and Seedless Late were selected and experiment was laid out in randomized block design (RBD) with three replications. Results revealed that there was a strong correlation between the length and width of panicle in cultivar Shahi (0.97), China (0.93) and Late Bedana (0.59).The length of panicle was highly and positively correlated with fruit set in cultivar China (0.92), Shahi (0.82) and Late Bedana (0.87). A strong correlation between girth of panicle and fruit set was also observed in Shahi (0.94), Late Bedana (0.81) and China (0.55). Conclusively, the optimum length of panicle for maximum fruit set in Shahi was 36.85 cm while in China, optimum girth of panicle was 4.8 mm for higher fruit set. However, in Late Bedana, fruit set increases with increases of both panicle length and girth. Besides other traits, the characteristics of panicle determine fruit set and quality in litchi.

Keywords: Cultivars, correlation, panicle length, panicle girth, fruit set, litchi.

INTRODUCTION

Litchi is queen of fruit contains very good nutritive and medicinal values in fruits. It requires low temperature stress during winter for bumper flowering and fruiting (Marboh *et al.*, 2019). It is good source of vitamin-C. Litchi pericarp and seed are good source of total phenol with 7.5 - 62.2 mg GAE/g and 23.01 – 85.57 mg GAE/g, respectively (Lal *et al*., 2018) and pericarp browning of litchi is big challenges (Purbey *et al*., 2019). It produces panicle which is comprised of many primary and secondary dichasia act as fruiting body. Litchi expresses differential response to water stress (Marboh *et al*., 2018). The high temperature accelerates the emergence of panicle while low temperature slows down the panicle emergence and delays emergence period (Lal *et al*., 2019a). The induction of flowering depends on internal as well as external factors. Lal *et al*., (2019b) observed that phenol content in litchi tree varied from year to year but phenol content in flowering tree were always more compared to non-flowering trees. Litchi bears either loose or compact panicle depending upon cultivars and prevailing climatic condition. It bears three types of flower 1) male (M1) flower, 2) pseudo-hermaphrodite male (M2) flower and 3) pseudo-hermaphrodite female (F) flowers. Male M1 flowers bloom first followed by pseudo-hermaphrodite female (F) which overlap with pseudo-hermaphrodite male M2 flowers (Lal, 2018). However, fruit set is governed by the pollen grains (Lal *et al*., 2019c and 2019d). The fruit set is determined by nature of pollination (self or cross) (Lal *et al*., 2021b) and effective pollination period (Lal *et al*., 2021a). Litchi cultivars may be divided into three groups: Shahi, China and Bedana. Panicle bears fruit and its length as well as girth has important role on production of litchi. The objective of this experiment was to assess the relationship among panicle, fruit set and quality of litchi.

MATERIALS AND METHODS

A study was conducted in National Active Germplasm Site (NAGS) at ICAR-National Research Centre on Litchi, Muzaffarpur (Bihar) in 2017 and 2018. Three cultivars of litchi namely China, Shahiand Late Bedana of 10 years old were selected and experiment was laid out in randomized block design (RBD) with three replications. The observations were taken on panicle length, width and girth, fruit set, fruit weight and TSS during 2017 and 2018.Ten shoots were tagged in each cultivar in four directions and length and girth of panicle measured at fully developed stage while number of fruit set was counted at harvest. Length and

width of panicle was measured at the longest and widest part and expressed in centimeter while girth of panicle was measured at the base of shoot and expressed in millimeter. The number of fruits was counted from the tagged panicle and number of fruit set was calculated against female flowers. Total soluble solids were measured at room temperature using digital refractometer and were expressed in terms of ^{0}Brix. Five fruits per replication were taken from each cultivar for taking the average value. The correlation and regression of panicle data were analyzed by SAS software.

RESULTS AND DISCUSSION

A. Relationship between length and width of panicle

Throughout the panicle development period, a strong positive correlation was observed between the length and width of panicle (Fig. 1) over the times in both years in all three cultivars *viz.*, China (0.93); Shahi (0.97) and Late Bedana (0.59). The number of florets per inflorescence was correlated to the length of the inflorescence in litchi (Lee, 2006). Panicle width increased with the increment in length in China and Shahi but in Late Bedana, the maximum width of panicle was noted when panicle length was about 22 cm. Beyond this, panicle width decreased with progressive increment in panicle length. A positive relationship has been reported between length and width of panicle in three cultivars of litchi (Lal *et al*., 2020) *viz*., Rose Scented (0.989), Mandaraji (0.970) and Seedless late (0.771).

B. Relationship between length of panicle and fruit set

There was a strong positive correlation between panicle length and fruit set (Fig. 2) over the times in both years in cultivar China (0.92), Shahi (0.82); Late Bedana (0.87).

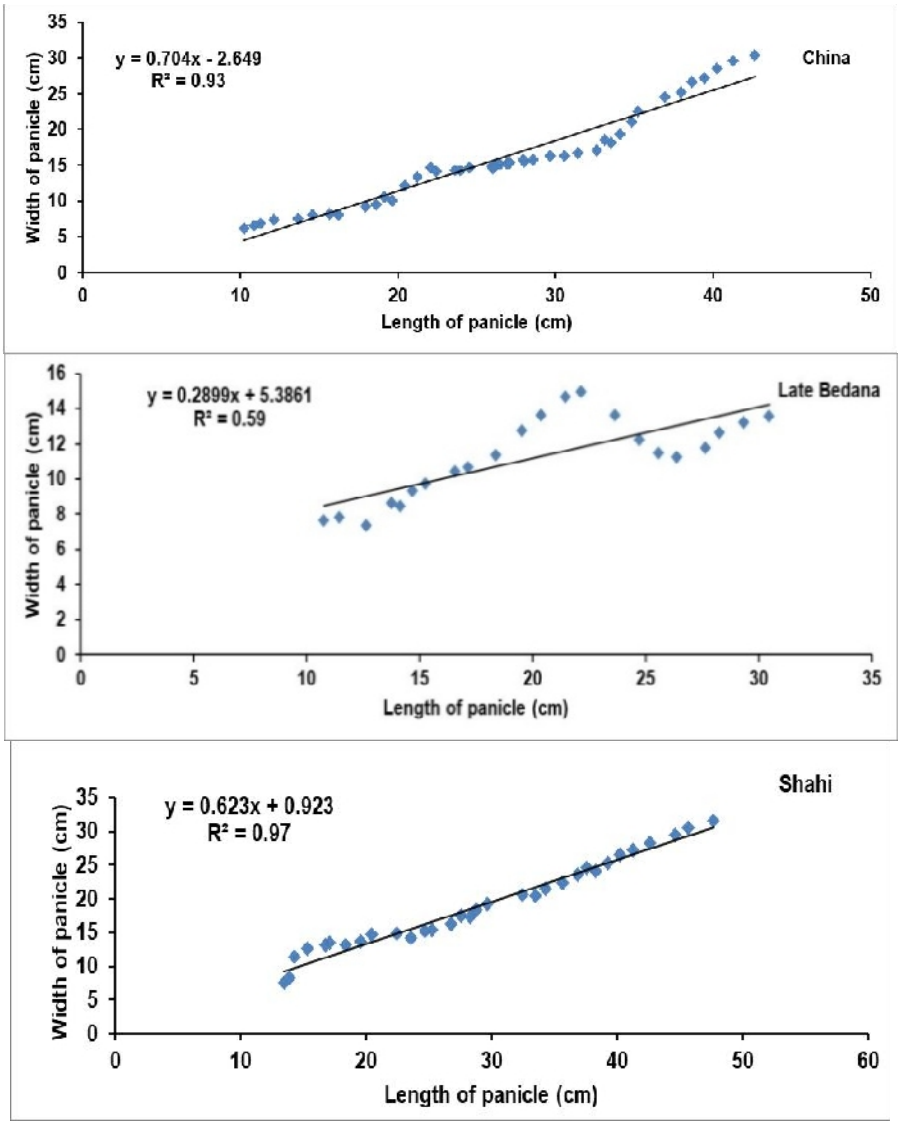

Fig. 1. The relationship between length and width of panicle in litchi cultivars.

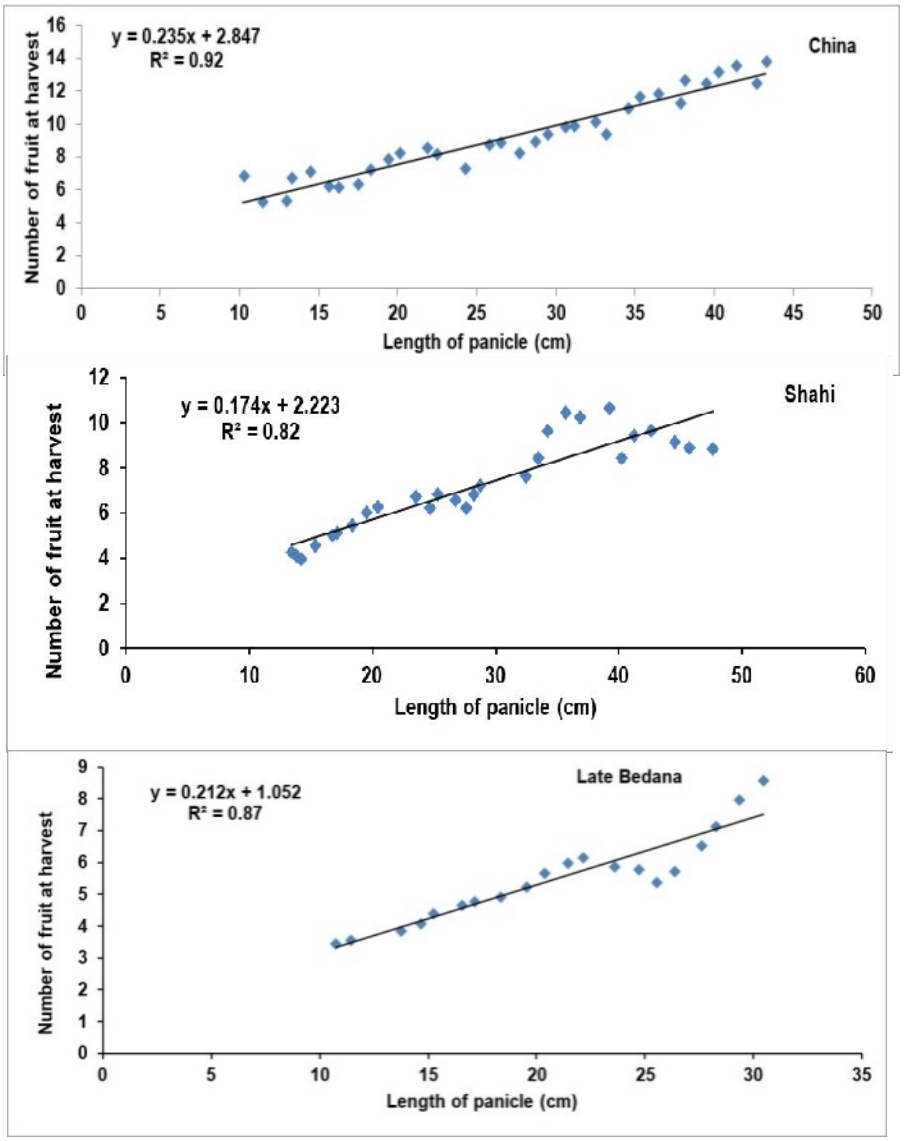

Fig. 2. The relationship between panicle length and fruit set in litchi cultivars.

Chen *et al*., (2013) also have shown positive relationship between the number of fruit set and length of the inflorescence, with optimum length about 20 cm. In China and Late Bedana, fruit set increases linearly with increases in length of panicle but in Shahi, the maximum number of fruits (11.24) was obtained when panicle length was 36.85 cm. Results revealed that optimum size of panicle is needed for higher production of fruits in cultivar Shahi. The length of panicle determines litchi production by attracting more pollinators effectively or by increasing the number of flowers. Pollinator attraction is highly dependent on the number of flowers open at a time. However, larger panicle may carry more number of female flowers which lead to more number of fruit set. The number of fruit was positively correlated with the number of flowers per inflorescence (Suetsugu *et al*., 2015). The results indicated that growth of panicle length should be allowed to the maximum possible extend in the cultivars China and Late Bedana for higher fruit set but in Shahi, panicle length should be restricted to 36 cm for higher fruit production.

C. Relationship between length and girth of panicle

A strong positive correlation between length and girth of panicle (Fig. 3) was found over the times in both years in cultivar Shahi (0.65) and Late Bedana (0.92) while China showed weak positive correlation (0.22). A very strong positive correlation between length and girth of panicle in Late Bedana (0.92) observed in our study was due to genetic make-up of the plant in having mechanism that naturally restrict the length of panicle. The length of panicle (30 cm) in Late Bedana made it efficient enough to utilize photosynthates and water in improving the girth of panicle while in Shahi and China, length of panicle were more (40 cm). Saheda *et al.,* (2019) have shown that length of inflorescence in mango was positively associated with width of inflorescence.

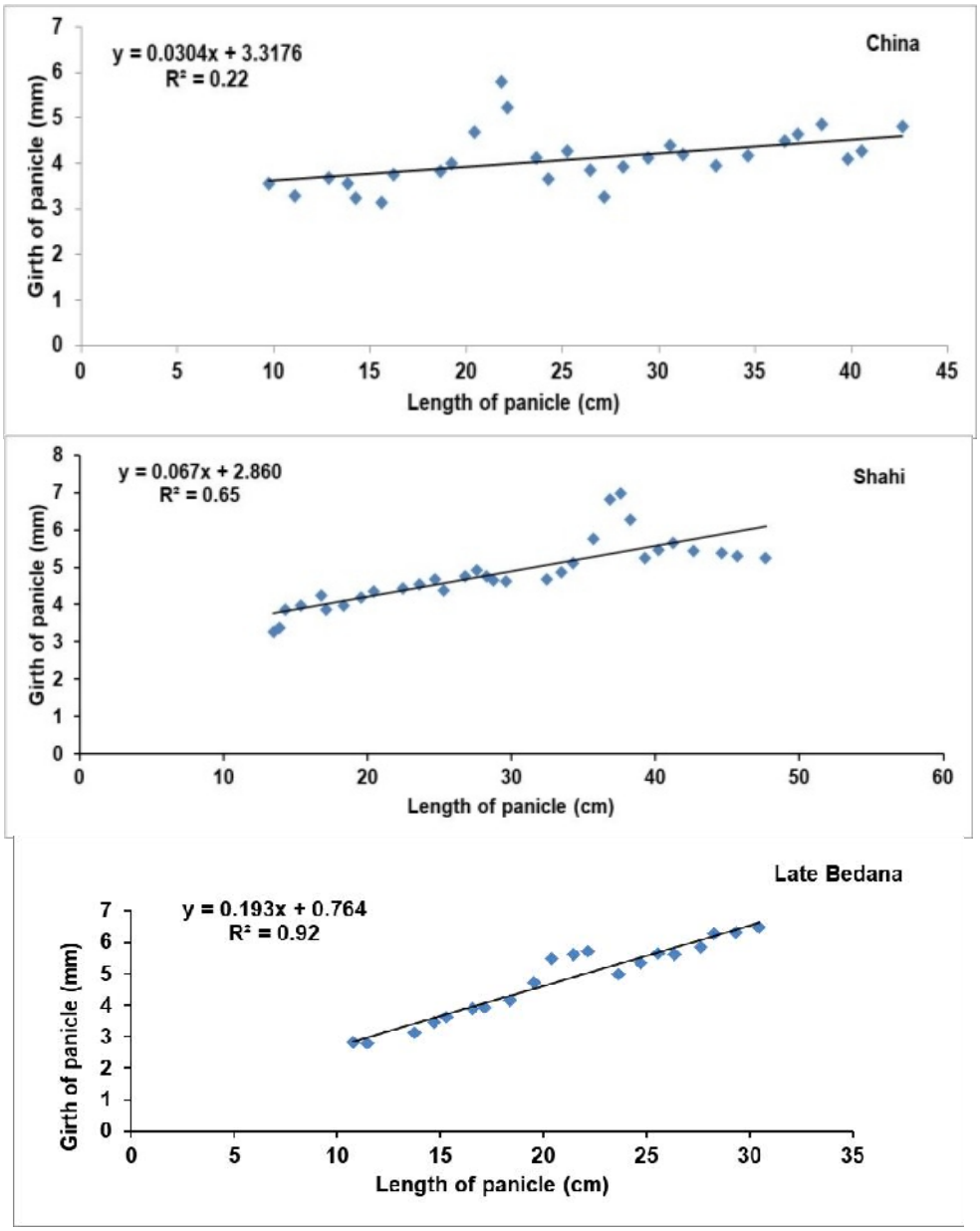

Fig. 3. The relationship between length and girth of panicle in litchi cultivars.

D. Relationship between girth of panicle and fruit set

All cultivars exhibited a very strong positive correlation between girth of panicle and fruit set (Fig. 4) *viz*., China (0.55), Shahi (0.94) and Late Bedana (0.81). In China, number of fruit set was highest (13.85) when girth of panicle was about 4.8 mm while in Shahi and Late Bedana fruit set increases with increases in girth of panicle. The higher girth of panicle provides good cambial activity which promoted flower bud initiation by maintain higher auxin: gibberellin ratio (Luo *et al*., 2005). This reflect active xylem and pith cell capable to provide food materials to the developing fruit results in retention of more number of fruits (Bustan *et al*., 2011). More thickness of panicle might be helpful in translocation of more food materials and water to developing fruit results in good fruit retention.

E. The relationship among girth of panicle, fruit weight and TSS

A strong positive correlation between girth of panicle and fruit weight was noted in two cultivars *viz.*, Shahi (0.56) and Late Bedana (0.76) while weak positive relation (0.26) was observed in China. A very strong correlation between girth of panicle and fruit weight in Late Bedana (0.76) can be attributed to increased girth of panicle which had provided more nutrients and water into the growing fruits resulted in higher fruit weight. Litchi fruit quality is highly affected from climatic factors as well as crop load. Nagraj *et al.,* (2019) concluded that least fruit load resulted in maximum fruit and pulp weight in litchi.

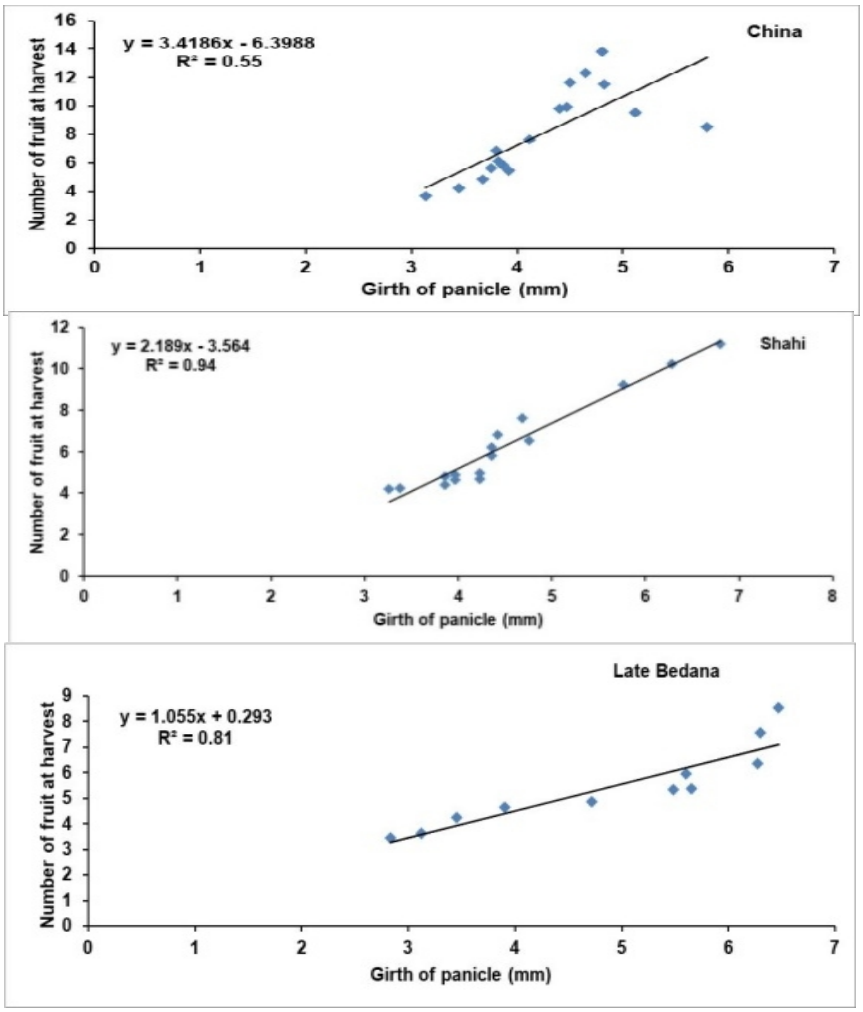

Fig. 4. The relationship between girth of panicle and fruit set in litchi cultivars.

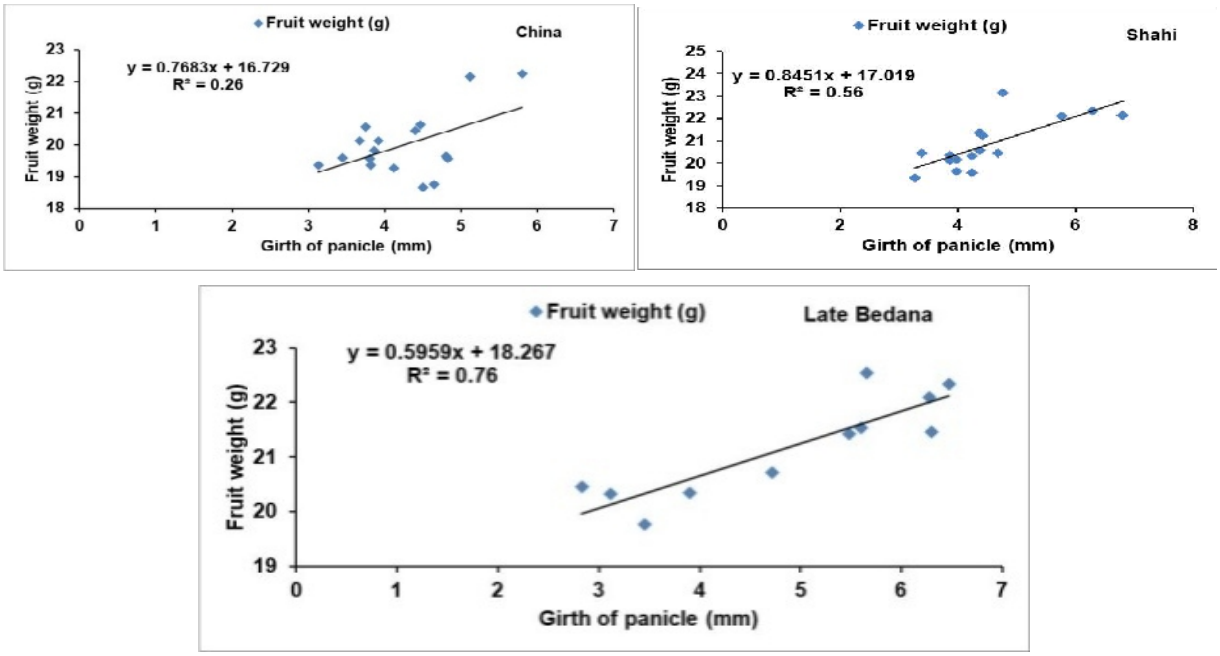

Fig. 5. The relationship between girth of panicle and fruit weight in litchi cultivars.

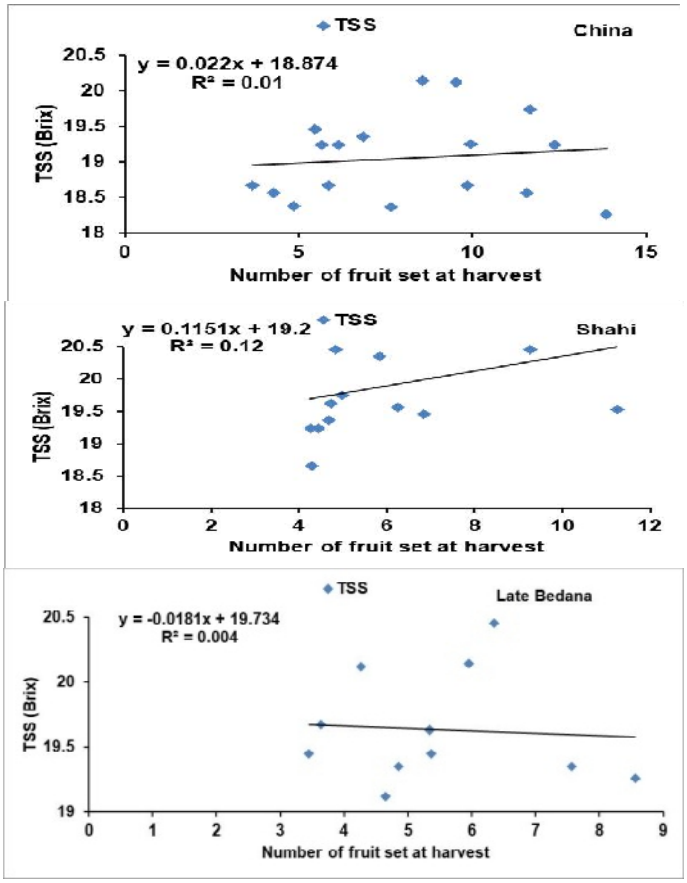

Fig. 6. The relationship between number of fruit set and TSS in litchi cultivars.

CONCLUSION

The length of panicle exerted a positive correlation with width and girth of panicle which has significant role in carrying maximum number of fruits per panicle at harvest. Irrespective of cultivars, length and girth of panicle exerted a positive influence on fruit set. However, in Shahi, length of panicle rather than girth of panicle played a great role in determining fruit set while in Late Bedana, both length and girth of panicle were crucial for fruit set. For genetic improvement in litchi, emphasis should be given on improvement of length and girth of panicle. This study provide insights to litchi breeder in selecting promising genotypes during selection with consideration of panicle length and girth.

FUTURE SCOPE

The effect of panicle on fruit set and fruit quality should be studied in all the cultivars of litchi. Litchi cultivar Swarna Roopa produces very weak panicle lead to heavy fruit drop and poor quality. The work may be carried out on panicle improvement in this cultivar to improve the fruit set as well as quality as present study has indicated that panicle characteristics is very important to ensure good fruit set and fruit weight.

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Conflict of Interest. The authors have declared that no competing interests exist.

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