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Effect of Branch Circumference Girdling on Fruit Yield in Neem (*Azadirachta indica*)

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Abstract: This study was conducted at Bhubaneswar, Odisha to evaluate the effect of girdling on *Azadirachta indica* (Neem) fruit yield and quality. A five-year-old neem tree was subjected to 25, 50, 75 and 100%, girdlingof branch circumference, with ungirdled branches as a control. Observations included fruit morphology and the time taken to reach maturity fruit drop percentage. Among the treatments, 50% girdling yielded the best results, with maximum fruit diameter (11.66 mm), length(16.37 mm), weight (1.34g/fruit), and seed dry weight(0.35 g/fruit). It also reduced fruit drop and shortened the maturity period. In contrast, complete girdling causes excessive fruit drop and reduced seed weight. Wound healing was slower in thicker branches, requiring more than 60 days. The study concluded that 50% girdling in neem trees would be useful for increasing the fruit parameters and yield.

Keywords: *Azadirachta indica*, Fruit parameter, Girdling, Neem

Azadirachta indica A. Juss. is commonly known as Neem belonging to family Meliaceae. Neem is known for benefits of its fruits, seeds, oils, leaves, roots and bark in Ayurveda and Unani system of medicine. Neem based preparations are efficacious against skin diseases and used for cosmetics, soaps, lubricants and biofertizer. The tree is usually evergreen, making it an excellent shade tree in summer. The panicles of greenish white flowers appear in the first week of April in North India, central India, and Tamil Nadu, and in the first week of May in the sub-Himalayan region (Mitra 1963). The fruits ripen from June to August. Neem is a strong light demander and can withstand droughts. The neem is a sturdy tree that can adapt to a wide range of climatic, edaphic, and topographical conditions. It thrives well in areas with temperature from 40 to 42.5C, annual rainfall of 450-1200 mm, and well drained acidic soil. Water logging and poorly drained soils are unsuitable for neem. The rate of growth of neem in plantations varies considerably depending mainly on the quality of the soil. The data taken from three, 15 years old neem trees at Pune showed that each neem tree produced approximately 400 kg of wood (Kalla et al., 1978).

Often, the trees do not bear fruits, although are in good health and may not show any apparent disease symptoms. Two chemical elements in organic matter are extremely important, especially in proportion to each other: carbon and nitrogen. The growth and fruitfulness of plants are greatly influenced by the relative proportions of carbohydrates and nitrogen (Miller 2000, Kunte and Yawalkar 2005).Girdling is a horticultural practice that involves the removal of a complete ring of bark from a tree trunk or branch, thereby blocking the downward translocation of photosynthates and metabolites through the phloem. This increases foliar carbohydrates (sugars and starch) and plant hormones in the upper parts of the girdle, which enhances floweringand fruit-bud formation. Other important materials, such as hormones, amino acids and minerals move in the bark in the same direction (Ticho 1970). As a result of girdling the leaf N content, the C/N ratio and carbohydrate content improved. Therefore, flowering and fruit sets increase (Shao et al., 1998). It was observed that 1/4th (25%) girdling of trunk girth by removing 2mm bark in the last week of March exhibited best performance in terms of improvement in flower and yield parameters namely- no. of flowers/shoot, per cent fruit set, no. of fruits per shoot and total yieldin *Actinidia delicoisa* (Azizi et al., 2022). Praveen et al. (2025) reported wide variety of fruit species are girdled to induce flowering, improve fruit set, increase in yield, enlarge fruit size, advance maturity and improve quality. Keeping in view the importance of fruit and seed of neem plant, the present study was designed to study the intensity of girdling of branches in increasing the fruit morphology and yieldin Neem.

MATERIAL AND METHODS

The experiment was conducted during 2025 in the field of AICRP (Agroforestry), OUAT, Bhubaneswar, which is located at 20^{0}27'99" N latitude and 85^{0}78'30" E longitude. The trees were planted at 8x3m^2 alleys. Neem trees (5 years old) with tertiary branches bearing 8–10 inflorescences were selected. Experiment was laid out in a completely randomized design with five treatments namely T1 – Control (no girdling); T2, T3, T4, T5 25, 50, 75 and 100% girdling of branch circumference and were replicated fourtimes.

Girdling treatments were done in the 2nd week of April, 2025 just at the start of flowering stalks. Girdling was

performed using a 4 mm wide girdling knife. In the partial treatments, the respective percentage of bark circumference (4mm wide) was removed without damaging the xylem, whereas in T5, a complete circular ring was removed. Immediately after girdling, the following parameters were recorded for each selected branch: branch diameter, number of inflorescences, fruit setting time, total number of fruits per branch, fruit length, fruit diameter, fresh weight of fruit and dry weight of seeds. From each replication, 20 fruits were measured and the average value per fruit and seed with respect to fruit and seed morphometric parameters were worked out. The fruit parameters were measured by electronic calliper and fruit weight was measured.

RESULTS AND DISCUSSION

Fruit and seed morphometric characters: The treatment T2 (25% girdling) recorded maximum days (40) taken for maturity of fruits from fruit set, whereas in T3 (50% girdling of branch circumference) took minimum days (31). The maximum fruit diameter (11.6 mm) was in 50% girdling of branch circumference, and minimum (9.12 mm) was due to 100% girdling (Table 1). Maximum fruit length (16.37 mm) was observed in response to 50% girdling and (13.91 mm) was due to no girdling (Table 1). The fruit length in T4 (15.25 mm) was not found significantly different from T3. The maximum fruit weight (1.34 g) was observed in treatment exposed to 50% girdling of branch circumference and 0.79 g in control (no girdling). T_4 and T_3 *i.e.,* 75% and 50% branch girdling differed non-significantly from each other (Table 1). The maximum seed weight was 0.35 g in treatment response to 50% girdling and minimum (0.29 g) in treatment response to 100% girdling of branch circumference. Length-to-diameter ratio was maximum (1.62) in 100% girdling of branch circumference and was least (1.38) in 50% girdling. The 100% girdling of branch circumference was significantly different from all other treatments (Table 1). The pulp weight was maximum (0.99g) in treatment response to 50% girdling, and minimum (0.48) in control (Table 1).

Initial and final number of fruits, fruit drop, fruit retention, days taken to fruit set and days taken to mature from fruit set was recorded among different branch gridling treatments. All these parameters showed significant variation among the treatments (Table 2). Initial number of fruits was more (23.25) due to 25% girdling of branch circumference (T2), and minimum (15.25) in control (Table 2). Final number of fruits at maturity ranged between 6.75 (control) to 15.75 (50% girdling of branch).

Considering fruit retention and drop in Neem, T3

Table 1. Fruit morphometric characteristics as influenced by branch girdling treatments in Neem

Treatments	Fruit diameter (mm)	Fruit length (mm)	Fruit weight (g)	Seed dry weight (g)	Pulp dry weight (gm)	L/D
T1	9.72	13.91	0.79	0.31	0.48	1.43
T2	10.13	14.57	0.95	0.31	0.64	1.53
T3	11.66	16.37	1.34	0.35	0.99	1.38
T4	10.15	15.25	1.10	0.30	0.80	1.50
T5	9.12	14.55	0.90	0.29	0.61	1.62
CD (p=0.05)	0.92	2.24	0.23	0.26	0.18	0.19
CV (5%)	6.02	1.41	13.31	18.66	11.81	7.77

Note: T1 – Control (no girdling); T2 – 25% girdling of branch circumference; T3 – 50% girdling of branch circumference; T4 – 75% girdling of branch circumference; T5 – 100% girdling of branch circumference; L/D-Length-to-Diameter ratio

Table 2. Fruit setting, fruit maturity, fruit retention in different treatments in Neem

Treatments	Initial no. of fruits	Final no. of fruits	Fruit drop (%)	Fruit retention (%)	Days taken to fruit set	Days taken to mature from fruit set
T1	15.25	6.75	55.34	44.65	6.00	36.25
T2	23.25	13.00	42.98	57.02	9.00	40.00
T3	21.25	15.75	29.46	70.54	10.75	31.25
T4	18.25	8.50	52.99	47.01	7.00	38.75
T5	22.00	10.50	55.37	44.63	7.00	39.75
CD (5%)	15.56	12.77	27.09	27.84	5.94	6.76
CV (5%)	7.31	11.00	27.06	4.95	7.02	8.53

See Table 1 for details of treatments

treatment (50% girdling) recorded maximum fruit retention (70.54%) and was minimum (44.63%) in T5 (100% girdling). Maximum fruit drop (55.37%) was in T5 (100% girdling of branch circumference), which was significantly different from all other treatments. However, T3 (50% girdling) resulted in 29.46 per cent fruit drop (Table 2). The period of fruit set ranged from 6 (control) to 10.75 days (50% girdling of branch circumference), while fruit maturation also varied among branch girdling methods. The maximum fruit harvesting period was 40 days in T2 with 25% branch girdling and the minimum fruit harvest period (31.25 days) was observed in trees subjected to 50% girdling of branch circumference (Table 2).

Branch girdled wound healing time: The branches of diameter less than 10 mm healed first (within 30 days) than branch diameter between 10 mm to 15 mm. However, the branches with diameters greater than 15 mm took more than 60 days' time for healing. The 50% girdling of branch circumference (T3) yielded the best results among all the treatments. It produced the largest fruit diameter, fruit length, highest fruit weight, pulp weight and maximum seed weight (19.96, 17.69, 69.62, 106 and 12.90%, respectively) more in comparison to control. In T3, final number of fruits at maturity, and per cent fruit retention were maximum. The 50% girdling of branch circumference recorded the lowest with respect time for fruit maturity (31.25 days) and fruit drop (29.46%) compared to 36.25 days and 55.34%, respectively as in control. Partial girdling allowed regulated stress by restricting phloem transport without completely blocking water and nutrient movement, thereby concentrating the assimilates in the fruit. In contrast, 100% girdling (T5) caused excessive stress, leading to smaller fruits and higher fruit drops. These results are consistent with earlier findings (Khandaker et al., 2011, Gawankar et al., 2019), where better fruit growth and oil content with partial girdling as compared to full girdling. Girdling treatments advanced the fruit maturity over control in 18-year-old “Patharnakh” Pear as reported by Singh et al. (2014). The healing of girdled wounds varied with branch thickness; branches <10 mm healed within 30 days, whereas those >15 mm required more than 60 days, suggesting that thicker branches are more suitable for girdling. The wound healing duration of girdled portion increases with increasing the size of girdling notch in *Litchi chinensis* (Kumar et al. 2017) which is consistent with the findings of the present study.

CONCLUSION

The 50% girdling of branch circumference was the most effective treatment that produced bigger fruits with higher fruit weight, faster maturity, and dropped less fruits. Branches with a diameter greater than 15 mm were more suitable for girdling, which also showed better healing capacity. Therefore, 50% girdling in tertiary branches with more than 15 mm diameter just at the start of flowering in the 1st week of May is recommended for better fruit size quality and yield.

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AUTHORS CONTRIBUTION

T.L. Mohanty is the project supervisor who designed the experiment. Utpalika Hota is the research scholar who conducted the research trial. M.C. Behera has organised and managed the data. S.G. Nair has analysed and interpreted the data. H. Nayak has helped in facilitating the field for the study.

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