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Response of Planting Time of Glue Corn (Zea Mays Ceratina) Intercropped with Peanuts (Arachis Hypogaea) to Growth and Yield

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ABSTRACT: This study aims to evaluate the growth response and yield performance of glutinous corn (Zea mays var. ceratina) under various peanut planting times in an intercropping system. The research was conducted from May to September 2025 in Dusun Kukub, Perean Tengah Village, Baturiti District, Tabanan Regency, using a one-factor Randomized Block Design (RBD) with five planting time treatments, namely T0 (corn monoculture), T1 (simultaneous planting), T2 (corn planted 7 days after peanuts), T3 (14 days after peanuts), and T4 (21 days after peanuts), each repeated five times. The observed variables included vegetative growth (plant height, stem diameter, and number of leaves) and yield components (cob length, cob diameter, number of grains per cob, number of rows per cob, and yield weight). Data were analysed using ANOVA followed by the Least Significant Difference (LSD) test at 5%. The results of the study indicate that variations in peanut planting time have a significant effect, which is very evident in all parameters of glutinous corn growth. Treatment T2 produced the best performance for stem diameter, plant height, and number of leaves, while T4 consistently produced the lowest values due to stronger early competition. For ear yield components, none of the parameters showed significant differences ($p>0.05$), although the highest numerical values were still recorded in treatment T2. Fresh ear weight, fresh weight per plant, and fresh weight per plot also did not differ significantly but followed an increasing trend in T2 and a decreasing trend in T4. Overall, a 7-day planting interval (T2) proved to be the most effective in balancing competition and improving nitrogen use efficiency in the maize–peanut intercropping system. These findings indicate that planting timing is an important agronomic factor in optimising maize productivity in intercropping systems.

KEYWORDS: Waxy Corn, Peanut, Intercropping, Planting Time, Growth, Yield.

I. INTRODUCTION

Agriculture is a strategic sector in supporting food security, poverty reduction, and sustainable development (1). In the face of increasing food demand and climate change pressures, the implementation of these sustainable agricultural systems is becoming increasingly important. One widely used approach is intercropping, which involves planting two or more commodities on the same land at approximately the same time. This system has proven to increase landing efficiency, optimize nutrient uptake, and improve resistance to pests and diseases (2).

Corn and peanuts are a potential combination of crops for intercropping. Corn, as a crop with high nutrient requirements, can benefit from the ability of peanuts to fix nitrogen. Previous studies have shown that a combination of legumes in intercropping can increase land efficiency and the yield of the main crop (3).

The success of this system is greatly affected by the timing of planting, as improper timing can significantly increase competition for light, water, and nutrients. However, the optimal timing can enhance plant synergy and system productivity (4).

In Nagekeo Regency, East Nusa Tenggara, intercropping corn and peanuts has become a common practice with simultaneous planting times. However, scientific findings showed that there is potential for increased productivity through more precise planting time management. Therefore, research on the response of corn plants to variations in peanut planting times in intercropping systems is required to obtain optimal corn growth and yields.

II.RESEARCHMETHOD

The study was conducted in Kukub Hamlet, Perean Tengah Village, Baturiti District, Tabanan Regency, from May to September 2025. The materials used included Arumba F1 sweet waxy maize seeds, cattle manure, NPK fertiliser, Regent systemic pesticide

(Fipronil 5 g/L), Score systemic fungicide (Difenoconazole 250 g/L), Furadan, and dolomite lime. The tools used consisted of cultivation equipment (hoes, machetes, sickles, measuring tape, raffia rope, and gasrok) as well as measurement and writing tools (notebooks, pens, rulers, callipers, measuring tape, and scales). The experiment used a Randomised Block Design (RBD) with one factor: planting time in the intercropping system (T), consisting of five treatment levels:
T0 = Waxy maize monoculture
T1 = Waxy maize planted simultaneously with groundnut.
T2 = Waxy maize planted 7 days after groundnut
T3 = Waxy maize planted 14 days after groundnut.
T4 = Waxy maize planted 21 days after groundnut
Each treatment was repeated five times, resulting in 25 experimental units with plot dimensions of 225 cm × 150 cm and a spacing of 30 cm × 30 cm. The implementation stages included site survey and land preparation, planting, maintenance (thinning, weeding, and pest and disease control), and harvesting at physiological maturity. Basal fertilisation was applied during bed preparation using 3.38 kg of cattle manure per plot. Top-dressing with NPK was conducted three times using 0.10 kg per plot at 1, 7, and 12 weeks after planting. Observed variables included growth components (plant height, number of leaves, and stem diameter) and yield components (ear length, ear diameter, number of ears per plot, number of kernels per ear, number of rows per ear, fresh ear weight per plant, and fresh ear weight per plot). Data were analysed using analysis of variance (ANOVA) at a 5% significance level. If significant differences were detected, the analysis was followed by the Least Significant Difference (LSD) test at the 5% level.

III.RESULTS

Analysis of variance shows that in the intercropping system of glutinous corn and peanuts, there is a very significant effect on corn plant height at all observation ages (14 dpa, 21 dpa, 28 dpa, 35 dpa, and 42 dpa).
The results of the 5% Least Significant Difference test (Table 1) show that at 14 days after planting, treatment T0 (corn monoculture) produced significantly higher corn plant height compared to (T1, T2, T3, and T4). Significant differences between treatments were apparent at 21 DAP,where T0 continued to produce the highest plant height and differed significantly from the other treatments. The same occurrence was also observed at 28, 35, and 42 days after planting, where T0 consistently showed better corn plant height growth compared to the other treatments in accordance with the results of the 5% Least Significant Difference test.

Table 1. Average plant height of waxy corn (cm) at various observation ages

Treatment	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
T0	21.40^{e}	40.29^{e}	93.72^{a}	116.80^{c}	145.20^{b}
T1	18.24^{c}	30.18^{c}	67.88^{b}	105.20^{a}	127.28^{b}
T2	16.15^{d}	38.26^{d}	66.62^{d}	91.80^{d}	118.92^{c}
T3	14.20^{b}	22.49^{b}	50.16^{c}	66.64^{b}	116.40^{b}
T4	12.17^{a}	20.71^{a}	35.44^{c}	59.84^{a}	95.32^{a}

Note: Numbers in the same column followed by different letters indicate significant differences based on the 5% LSD test.

Analysis of variance shows that the treatment of peanut planting time in the intercropping system has a significant effect on the stem diameter of sticky corn (Zea mays var. Ceratina) at all observation ages (14, 21, 28, 35, and 42 days after planting). The results of the 5% Least Significant Difference test (Table 1) show that at 14 DAP, treatment T2 produced the highest stem diameter and was significantly different from T0, T1, T3, and T4. At 21 DAP,all treatments showed no significant differences. From 28 DAP to 42 DAP, the pattern of differences among treatments was consistent, with T2 consistently producing the highest stem diameter, while T4 produced the lowest stem diameter and was significantly different from the other treatments according to the 5% Least Significant Difference test. Overall, treatment T2 was the highest treatment in increasing the stem diameter of sticky corn, while T4 tended to produce the lowest diameter in that growth phase.

Table 2. Average stem diameter of waxy corn (cm) at various observation ages

Treatment	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
T0	0.36^{b}	0.55^{a}	1.31^{b}	1.68^{c}	1.92^{c}
T1	0.32^{b}	0.47^{a}	1.09^{b}	1.41^{b}	1.60^{a}
T2	0.55^{a}	0.85^{a}	1.56^{b}	1.86^{c}	2.50^{b}
T3	0.27^{b}	0.32^{a}	0.89^{ab}	1.39^{b}	1.51^{a}
T4	0.26^{b}	0.28^{b}	0.59^{a}	0.84^{a}	1.33^{a}

Note: Numbers in the same column followed by different letters indicate significant differences based on the 5% LSD test.

Table 3. Average number of leaves of waxy corn at various observation ages

Treatment	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
T0	5.08^{d}	6.60^{b}	6.88^{b}	8.32^{b}	9.40^{b}
T1	3.76^{b}	4.92^{a}	5.61^{a}	7.92^{a}	8.00^{a}
T2	4.36^{c}	4.80^{a}	6.32^{b}	7.37^{b}	9.60^{b}
T3	3.72^{b}	4.92^{a}	5.28^{a}	6.04^{a}	8.92^{b}
T4	3.24^{a}	4.28^{a}	5.00^{a}	6.20^{a}	8.04^{a}

Note: Numbers in the same column followed by different letters indicate significant differences based on the 5% LSD test.

Analysis of variance shows that the treatment of peanut planting time in the intercropping system has a significant effect on the number of sticky corn leaves at all observation ages (14, 21, 28, 35, and 42 days after planting). The results of the 5% Least Significant Difference test (Table 3) showed that at 14 DAP, treatment T0 produced the highest number of leaves and was significantly different from the other treatments, followed by T4, which formed the lowest number of leaves. At 21 DAP, treatment T0 still showed a higher number of leaves and was significantly different from T1, T2, T3, and T4. From 28 DAP to 42 DAP, the pattern of differences between treatments remained consistent, with T0 continuing to show a higher number of leaves compared to the other treatments, whereas T1, T3, and T4 tended to be in the lower value group. Overall, T0 (corn monoculture) provided the best leaf growth at all observation ages, while T4 showed the lowest number of leaves based on the results of the 5% Least Significant Difference test.

Table 4. Average cob length, cob diameter, number of cobs per plot, number of kernels per row, and number of rows per cob for each treatment

Treatment	Cob Length (cm)	Cob Diameter (cm)	Number of Cobs/Plot	Kernels/Row	Rows/Cob
T0	16.18	4.30	5.80	27.32	11.01
T1	16.64	4.40	5.00	23.56	11.36
T2	17.96	4.54	5.60	27.55	11.48
T3	14.55	4.14	5.60	19.84	9.78
T4	13.73	3.81	6.00	17.41	9.88

The results of the analysis of variance (ANOVA) showed that the treatment had no significant effect on all observed cob component variables, including cob length, cob diameter, number of cobs per plot, number of seeds per cob, and number of rows per cob ($p>0.05$). The average cob length ranged from 13.73 to 17.96 cm, with no statistical differences between treatments. Treatment T2 showed the highest cob length (17.96 cm), but the 5% Least Significant Difference test confirmed that this value was not significantly different from T0, T1, T3, or T4. A similar pattern was observable in cob diameter, with an average value ranging from 3.81 to 4.54 cm. Although T2 had the largest cob diameter (4.54 cm), the ANOVA results confirmed that the difference was not statistically significant. The number of cobs per plot also showed a similar pattern, with the highest value found in treatment T0

(5.80). However, this value was not significantly different from the other treatments ($p > 0.05$), including T4, which had the lowest number of cobs (5.00).

The number of seeds per cob ranged from 17.41 to 27.55 seeds. Treatment T2 had the highest number of seeds (27.55), followed by T0 (27.32), while T4 showed the lowest value (17.41). However, based on the results of the 5% Least Significant Difference test, all treatments remained in the same group, indicating that the differences were not significant. Similarly, the number of rows per cob ranged from 9.78 to 11.48, indicating no statistically significant differences among treatments. Although T2 recorded the highest mean value (11.48 rows), this was not distinct from the other treatments

Table 5. Average fresh cob weight, fresh cob weight per plant, fresh cob weight per plot, fresh biomass weight, and oven-dry weight for each treatment

Treatment	Fresh Cob Weight (g)	Fresh Cob Weight per Plant (g)	Fresh Cob Weight per Plot (g)	Fresh Biomass (t/ha)	Oven-Dry Weight (t/ha)
T0	129.48^a	150.42^a	2392^a	907.4	219.17
T1	128.20^a	128.20^a	581^a	771.8	186.72
T2	161.39^a	175.64^a	938.20^a	1321.8	355.03
T4	76.88^a	82.26^a	393.30^a	320.0	122.25

Note: Numbers in the same column followed by different letters indicate significant differences based on the 5% LSD test.
ns = not significant at the 5% level according to the LSD test.

IV.DISCUSSION

The research results show that the timing of peanut planting in an intercropping system significantly affects the growth dynamics and yield of glutinous corn. In general, treatment T2 (corn planted 7 days after peanuts) showed the best tendency in almost all growth and yield parameters, while treatment T4 (peanuts planted very early) showed the opposite pattern. During the vegetative growth phase, corn in treatment T2 showed better development in stem diameter, plant height, and leaf number than in the other treatments. This condition reflects that a moderate planting interval can reduce early competition and create a balanced growth between the two species, as stated by Awidiyantini et al. [5], that effective planting intervals minimise early competition while maximising the nitrogen-fixing benefits from legumes.

Physiologically, intercropping corn and peanuts can be mutually beneficial because peanut roots release flavonoids that stimulate the reactivity of Bradyrhizobium in the rhizosphere. The increased activity of these nitrogen-fixing bacteria then enriches the availability of nitrogen in the soil, allowing corn to obtain a more optimal nitrogen supply [6]. This aligns with the report [7], the intercropping of corn and legumes can improve nitrogen use efficiency without inhibiting corn vegetative growth. On the other hand, the number of leaves in treatments T0 and T2 tends to be higher than in T4, indicating that intensive competition in the early phase, especially for light and root space as in T4, can suppress leaf formation and reduce the photosynthetic capacity of corn, consistent with the findings of [8] which state that the intensity of early-phase competition is highly determinant for canopy performance in the subsequent vegetative phase.

In the next phase, morphological components of the cob, such as cob length, cob diameter, number of cobs per plant, number of seeds per cob, and number of seed rows, were found to be not significantly different than other treatments. The numerical pattern remained consistent in supporting the superiority of T2. In this treatment, cob length (17.96 cm), cob diameter (4.54 cm), and number of seeds per cob (27.55) were the highest compared to other treatments. This pattern found that corn still benefits from the balance of competition and utilization of nitrogen fixed by peanuts, even though the differences are not statistically significant. This finding is in line with the report by Chen et al. [9] that corn-legume intercropping can increase seed filling and cob development through increased mineral nitrogen availability. In addition, Li et al. [10] noted that the stability of cob yield in intercropping systems is largely contingent upon the synchronisation of the species' growth phases. They emphasised that a moderate planting interval can facilitate more advantageous competitive dynamics, thereby supporting improved cob development.

On the other hand, T4 again showed low values in most cob parameters, indicating that early dominance of peanuts can suppress maize cob development, consistent with the findings of Zhao et al. [11], which stated that excessive competition in the early phase can reduce cob size and kernel number due to inhibited sink formation.

Yield components, such as fresh cob weight per plant, fresh cob weight per plot, fresh biomass weight, and oven-dry weight, still did not differ significantly, but T2 again showed the highest values. Fresh cob weight (161.39 g), fresh weight per plant (175.64 g), and fresh weight per plot (938.20 g) in this treatment indicate that better vegetative growth and balanced competition conditions contribute to higher yield formation.

On the other hand, T4 showed the lowest value because the more intense early competition resulted in a contraction in biomass and excellent grain filling. This finding is matched with [12], who reported that intense early competition caused corn to prioritize vegetative growth, resulting in lower assimilate allocation to grain filling.

Overall, the consistency of vegetative response patterns, cob morphology, and yield components indicates that the timing of peanut planting is a key factor in the success of the corn–peanut intercropping system. A medium planting interval (T2) provides an ideal balance of competition, maximizes the benefits of nitrogen fixation, and supports corn productivity until the yield formation phase. Although subfusc, some parameters did not differ significantly; the biological patterns that emerged provided strong indications that planting intervals are a critical agronomic strategy for enhancing the efficiency of intercropping systems. These findings align with Zhang et al. [13], who confirmed that proper planting timing can improve soil nitrogen balance and corn productivity in mixed cropping systems.

V.CONCLUSION

The study on the effect of peanut planting time in a maize–peanut intercropping system showed that planting time significantly influenced maize growth and yield components. Overall, the T2 treatment (maize planted 7 days after peanut) consistently provided the best performance across most growth parameters, including plant height, leaf number, and stem diameter, indicating an optimal balance between early competition and nitrogen benefits from legumes.

Although ear morphology and yield components (ear length, ear diameter, number of ears per plot, kernels per ear, and rows per ear) did not show statistically significant differences among treatments, the T2 treatment numerically showed superior values. Similarly, fresh cob weight per plant, fresh cob weight per plot, total biomass, and oven-dry weight were highest in T2, highlighting the agronomic advantage of moderate planting intervals.

In conclusion, planting maize 7 days after peanut is the most effective strategy in maize–peanut intercropping, as it minimizes early competition, maximizes nitrogen utilization, and supports optimal maize growth and productivity.

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