Research Article:

EVALUATION OF AGRONOMIC PERFORMANCE OF MAIZE VARIETIES UNDER SPRING SEASON IN KAILALI, NEPAL

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ABSTRACT

Maize (*Zea mays* L.) is a key cereal crop for food, feed, and industry, but its productivity in Nepal remains low compared to the global average. In the western Terai, yield of maize is constrained by the limited use of adapted hybrids and the lack of local evaluation. A field experiment was carried out from February to August 2024, in Kailali, Nepal, to evaluate the agronomic performance of spring maize varieties and identify suitable high-yielding options. The experiment was laid in Randomized Complete Block Design (RCBD) with three replications and seven treatments: RH-6, RH-10, RH-12, RH-16, CAH-1511, Arun-2 (OPV check), and Rajkumar (hybrid check). The plot size was 3 m × 3 m with 60 cm × 25 cm plant spacing, and a fertilizer dose of 150:60:60 :: $N:P_2O_5:K_2O$ kg ha^{-1} along with 4 t ha^{-1} poultry manure was applied with standard agronomic practices. Data on phenology, growth, yield attributes, and yield were recorded from ten randomly selected plants per plot. Analysis was performed using ANOVA for RCBD and mean separation using Fisher's LSD at 5% level, along with Pearson correlation analysis. Significant varietal differences were observed for plant height, time to tasseling and silking, length and weight of cob, kernel rows per cob, kernels per row, thousand kernel weight, grain yield, stover yield, biological yield, and harvest index. RH-10 recorded the highest test weight (353.26 g), while Rajkumar had the heaviest cobs (301.77 g). Grain yield was found to be highly and positively correlated with the number of kernel rows per cob, cob weight without husk, length of cob without husk, test weight, biological yield, and harvest index. CAH-1511 produced the highest grain yield (7.69 t ha^{-1}) and benefit-cost ratio (2.10), which was followed by RH-10. Overall, CAH-1511 and RH-10 exhibited superior agronomic performance, better yield components, and higher economic returns. Therefore, these varieties are recommended for spring maize cultivation in Kailali under similar agro-ecological conditions.

Keywords: Biological yield, economic analysis, grain yield, phenology, yield attributes, *Zea mays*

INTRODUCTION

Maize (*Zea mays* L.) ranks as the third most important cereal crop in the world, following rice and wheat (Shiferaw et al., 2011), serving as a staple, animal feed, and raw material for industries (Sah et al., 2023). It also provides essential nutrients such as carbohydrates, proteins, and vitamins, and plays a crucial role in global food and nutritional security (Ignjatovic-Micic et al., 2015; Palacios-Rojas et al., 2020). According to the Food and Agriculture Organization of the United Nations (2025), the United States, China, and Brazil are the leading producers of maize, which is cultivated on over 208 million hectares with a production of over 1.24 billion tons globally. However, in Nepal, maize ranks second after rice in both area as well as production, producing 3.49 metric tons per hectare of land on average (Ministry of Agriculture and Livestock Development, Government of Nepal, 2025). It has a significant contribution to food security, livestock feed, and family income, particularly in the hilly and Terai regions of Nepal (Timsina et al., 2016). However, the national yield of maize is far below the world average of 6–10 t/ha (Kandel & Shrestha, 2020). The adoption of hybrid maize has increased since the 1990s, but only 7–10% of the cultivated maize area is under hybrids, and their performance is inconsistent across diverse agro-climatic zones (Tripathi et al., 2016). Spring maize is mainly grown in Terai and river basin regions in Nepal and occupies about 14.2% of the total maize area, filling the cropping gap before summer maize and supplying feed for livestock and poultry (Ministry of Finance, Government of Nepal, 2021; Yadav et al., 2024). Despite the availability of high-yielding varieties, different constraints such as heat stress during flowering, irrigation dependence, nutrient limitations, and genotype × environment interactions reduce yield potential across locations (Marahatta, 2021; Thapa & Rawal, 2024).

Kailali district of the Sudurpaschim Province lags in maize productivity due to the limited availability of site-specific high-yielding hybrids and reliance on local landraces that often suffer from late maturity, small cobs, and pest infestation (Devkota et al., 2020; Dhakal et al., 2022; Tripathi et al., 2016). These production challenges highlight the need to identify promising varieties that are better adapted to the local spring season environment.

Previous studies in Nepal have demonstrated the potential of hybrid maize for yield improvement, yet evidence regarding their performance in the western Terai is scarce, especially under farmer field conditions (Tripathi et al., 2016; Koirala et al., 2020). There is limited research on selecting varieties for different agro-climatic conditions, which slows the promotion of modern cultivars suited to specific production niches and farmers' preferences. Most of the released varieties are not widely adopted because they are tested only at research stations and not evaluated under farmers' field conditions, resulting in lower production than expected (Sah et al., 2023). Thus, there is a need for systematic evaluation of newly released and registered maize hybrids to identify varieties that combine high yield potential with desirable agronomic traits (Bashyal et al., 2020). Therefore, the study was carried out to evaluate the performance of spring maize varieties. The objectives were to compare their agronomic traits under farmer-managed conditions and identify the most suitable variety for spring maize cultivation in the western Terai.

RESEARCH METHODS

Research site and research design

The research was conducted in Janaki Rural Municipality-2, Kalikapur, Kailali, Sudurpaschim Province, Nepal, at location coordinates of 28°35′52.88″N and 81°7′1.54″E during the 2024 spring season. The site lies in the Terai region with fertile alluvial soils and a tropical to sub-tropical climate that is characterized by hot summers and warm winters (Luitel et al., 2020; Shah & Schreier, 1985). Summer temperature of the region varies from 24 °C to 43 °C, while winter temperature varies from 5 °C to 19 °C, and annual rainfall averages 1840 mm (Chaulagain & Rimal, 2019). The average temperature of the experimental site over the experimental period was 26 °C, reaching a maximum of 46.69 °C and a minimum of 7.65 °C. The average relative humidity and total precipitation of the experimental site over the period was 50.44 % and 1416.82 mm, respectively (National Aeronautics and Space Administration, 2025). The initial soil analysis indicated a loamy texture, neutral pH, and moderate levels of N, P, and K in the experimental field.

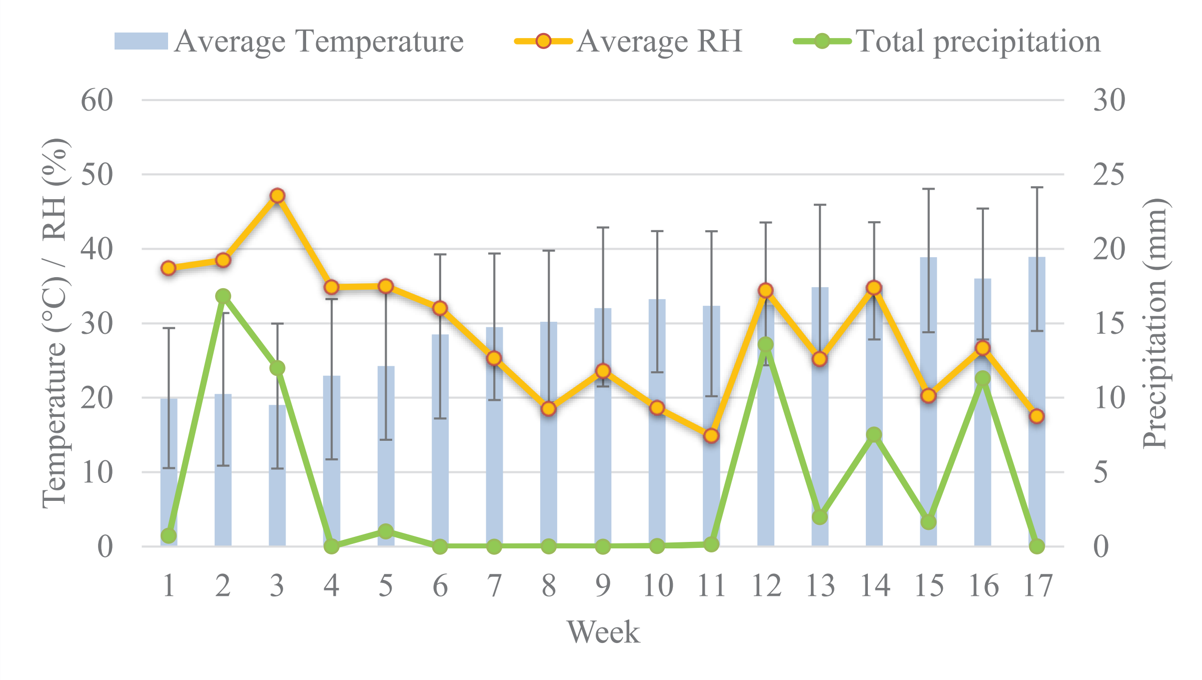

Fig. 1. Weekly weather data throughout the research period in Janaki, Kailali, Nepal, 2024

Note. Error bars represent the maximum and minimum temperatures.

The experiment used a Randomized Complete Block Design (RCBD) evaluating seven varieties and replicated thrice. Each plot was 3 m × 3 m (9 m²) in dimensions, with a spacing of 0.5 m between plots and 1 m across the blocks, giving a total of 21 plots across 300 m². The spacing between the plants was maintained at 60 cm × 25 cm.

Experimental materials

Seven maize varieties received from the National Maize Research Program, Chitwan, Nepal, were evaluated in the experiment. Poultry manure and chemical fertilizers, urea, DAP, and MOP, were used to provide the required nutrition to the plants. Poultry manure was applied at 4 t/ha (3.6 kg per plot). The chemical fertilizers were applied as per the recommendations of the Agriculture Information and Training Center (2024) at 150:60:60 NPK kg/ha, with DAP and MOP applied as basal fertilizers and urea applied in two splits at 25 and 50 DAS.

Table 1. Treatment details

Symbol	Treatment	Remarks
T1	RH-6	F1 hybrid Variety
T2	RH-10	F1 hybrid Variety
T3	RH-12	F1 hybrid Variety
T4	RH-16	F1 hybrid Variety
T5	CAH 1511	F1 hybrid Variety
T6	Arun-2	Local check
T7	Rajkumar	Standard/Hybrid check

Agronomic Practices

Field preparation was done on 19 February 2024. A tractor was used for primary tillage and a power tiller for secondary tillage. Maize seeds treated with Bavistin were sown on 23 February 2024 in 3m x 3m plots at a spacing of 60 cm × 25 cm. Two seeds were sown in each hill, and later thinned to one seedling at 19 DAS. Poultry manure and NPK fertilizers were applied as described above. Irrigation was applied six times during critical growth stages for water management. Weed control was done by hand weeding two times at 25 and 41 DAS both followed by earthing up, which also helped support plants. Major pests observed were aphids, fall armyworm, and stem borer, while rove beetles, ladybird beetles, and ground beetles were observed as beneficial insects. The insects were managed through manual removal and spraying of Emamectin benzoate @10 g a.i./ha, which was applied two times, once at 30 days and again at 45 days after sowing. Cobs were harvested at physiological maturity, sun-dried for four days, and then threshed using a motorized maize sheller.

Observation and data collection

Ten plants were selected randomly from three central rows in each plot, excluding border plants to prevent edge effect bias. The phenological traits recorded included days to 50% tasseling, days to 50% silking, and days to maturity. Growth traits included plant height, which was measured at an interval of 15 days from 30 DAS to 90 DAS. Yield-attributing traits included length and weight of each cob, kernel rows in each cob, kernel count per row, and thousand-grain weight. Yield traits were grain yield (kg/ha, adjusted to 12% moisture), stover yield, biological yield, and harvest index. Harvest index (HI) was calculated using the given formula (Donald, 1962):

$$HI = \frac{\text{Economic Yield}}{\text{Biological Yield}}$$

Data analysis and economic evaluation

MS Excel was used for data organization, while it was analyzed using the R software (version 4.5.0). ANOVA was performed according to RCBD, and Fisher's Least Significant Difference (LSD) was used to separate means at 5% significance level. Correlation analysis among selected traits was also conducted using a Pearson correlation matrix.

Economic analysis included the calculation of the cultivation costs, gross returns, net returns, and benefit-cost (B: C) ratio (CIMMYT, 1988).

$$\text{B:C Ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

Price of maize grain at harvest used for economic evaluation was referenced from the price in the local market, which was NPR 35/kg for hybrid variety and NPR 40/kg for open-pollinated varieties, while NPR 2/kg for maize stover.

RESULTS AND DISCUSSION

Phenological characters

Days to 50% tasseling

The ANOVA indicated that the varieties had a significant effect on days to 50% emergence of tassels, ranging from 64 to 70.33 days (Table 2). Early tasseling (64 days) was observed in Arun-2 and Rajkumar, whereas late tasseling (70.33 days) was recorded in RH-6. The grand mean of days to 50% tasseling was 66.80 days. The differences observed among the treatments were attributed to varietal differences. Bista et al. (2022) reported that the spring maize varieties took longer to reach tasseling than summer varieties due to slower early growth under low initial temperatures. Local and standard check varieties underwent tasseling in a shorter duration than the other varieties.

Days to 50% silking

The effect of different varieties on 50% silking (Table 2) showed a highly significant effect on 50% silking time. The duration for 50% silking ranged from 66 to 74 days. Rajkumar variety had the lowest days to 50% silking (66 days) compared to the local check variety Arun-2 (67 days), whereas late silking (74 days) was recorded in RH-6. The grand mean of days to 50% silking was 69.67 days. Hybrid varieties required more time to reach 50% silking than the local and standard check varieties. The significant differences observed among the treatments were attributed to varietal differences, as reported by Bista et al. (2022).

Tasseling silking interval

Tasseling silking interval differed significantly among the maize hybrids. RH-6 recorded the highest TSI (3.67 days), whereas Rajkumar recorded the lowest TSI (2.00 days). RH-10, RH-16, CAH-1511, and Arun-2 showed statistically similar TSI values of 3.00 days, while RH-12 recorded an intermediate TSI of 2.33 days and remained at par with Rajkumar. A lower TSI indicates better synchronization between tassel emergence and silk appearance, which generally favors efficient pollination and kernel set. In contrast, a wider TSI may indicate delayed silk emergence relative to pollen shedding and can reduce fertilization efficiency, especially under stress conditions (Borrás & Vitantonio-Mazzini, 2018; Zhuang et al., 2024).

Days to maturity

The average maturity time of maize was 107.19 days (Table 2). Among the tested varieties, Rampur Hybrid-6 (111.33 days) required the longest time to reach maturity, whereas the standard check variety, Rajkumar (104 days), attained maturity in the shortest duration. The observed differences in maturity duration are attributed to genetic variation among the varieties (Yadav et al., 2024).

Table 2. Phenological parameters of the maize varieties tested in the experiment in Kailali during 2024

Treatments	Days to 50% tasseling	Days to 50% silking	Tasseling silking interval	Days to Maturity
RH-6	70.33[a]	74.00[a]	3.67[a]	111.33[a]
RH-10	66.33[c]	69.33[c]	3.00[b]	105.00[cd]
RH-12	67.33[b]	69.67[c]	2.33[c]	111.33[a]
RH-16	67.67[b]	70.67[b]	3.00[b]	107.67[b]
CAH-1511	68.00[b]	71.00[b]	3.00[b]	104.67[cd]
Arun-2	64.00[d]	67.00[d]	3.00[b]	106.33[bc]
Rajkumar	64.00[d]	66.00[e]	2.00[c]	104.00[d]
SEm (±)	0.25	0.31	0.19	0.54
LSD (0.05)	0.77	0.97	0.59	1.67
F-test (0.05)	***	***	**	***
CV (%)	0.65	0.78	11.67	0.87
Grand mean	66.80	69.67	2.86	107.19

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; ***: Significant at 0.1% level; Means sharing the same letter within a column do not differ significantly at the 5% level according to Fisher's LSD test.

Biometrical observations

Plant height

The findings of the study observed significant differences in the plant height of the tested varieties (Table 3). At 30 DAS, RH-6 had the lowest plant height (35.74 cm), whereas Arun-2 recorded the highest (58.20 cm). At 45 DAS, RH-6 remained the shortest (110.06 cm), while Arun-2 attained the maximum height (172.80 cm), with the local check variety being statistically superior at this stage. At 60 DAS, Rajkumar (250.33 cm) exhibited significantly greater plant height than other varieties, whereas RH-6 remained the shortest (155.37 cm). At 75 DAS, RH-12 had the highest average height (307.35 cm), and RH-6 had the lowest (203.78 cm), with RH-12 being statistically superior to the local and standard check varieties. At 90 DAS, RH-6 still had the lowest height (206.00 cm), while RH-12 was the tallest (310.25 cm). The genetic differences and the combined influence of environmental factors play a role in height differences among different varieties (Qian et al., 2025), and the findings are also similar with previous reports (Bista et al., 2022; Kunwar & Shrestha, 2014; Neupane et al., 2020; Radma & Dagash, 2013).

Table 3. Plant height of the maize varieties tested in the experiment at Kailali during 2024

Treatments	30 DAS (cm)	45 DAS (cm)	60 DAS (cm)	75 DAS (cm)	90 DAS (cm)
RH-6	35.74^{b}	110.06^{c}	155.37^{d}	203.78^{e}	206.00^{e}
RH-10	37.25^{b}	131.56^{b}	205.63^{bc}	276.88^{c}	279.94^{c}
RH-12	38.65^{b}	134.41^{b}	217.73b	307.35^{a}	310.25^{a}
RH-16	40.47^{b}	123.83^{bc}	195.10^{c}	256.91^{d}	259.90^{d}
CAH-1511	40.22^{b}	135.02^{b}	212.77^{b}	281.38^{b}	283.30^{b}
Arun-2	58.20^{a}	172.80^{a}	249.85^{a}	281.90^{b}	284.06^{b}
Rajkumar	53.14^{a}	169.27^{a}	250.33^{a}	275.56^{c}	278.70^{c}
SEm(±)	2.78	5.72	5.06	0.69	0.60
LSD	8.57	17.63	15.60	2.14	1.72
F-test (0.05)	***	***	***	***	***
CV%	11.10	7.10	4.12	0.44	0.35
Grand Mean	43.39	139.56	212.40	269.11	271.73

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; DAS: Days after sowing; ***: Significant at 0.1% level; Means sharing the same letter within a column do not differ significantly at the 5% level according to Fisher's LSD test.

Yield attributing characters

Cobs per plant

The number of cobs differed significantly among the varieties (Table 4). The grand mean of cobs per plant was 1.07. RH-16 produced the most cobs per plant (1.33), while Arun-2 (1.13) and Rajkumar (1.07) also produced higher cob numbers compared to the other varieties.

Kernel rows per cob

The research produced 14.51 rows of kernel per cob on average (Table 4). The tested varieties varied significantly in the rows of kernels produced per cob. Rajkumar variety (15.93) had the most rows of kernels per cob, and the fewest rows per cob were recorded in Arun-2 (12.93). Standard check variety comes out with superiority in kernel rows per cob. The significant variation among the varieties is due to the genetic variation, as supported by Neupane et al. (2020).

Kernels count per row

The varieties differed significantly in the number of kernels in each row (Table 4). Rajkumar variety had most kernels per row (39.47), and the least kernels were found in RH-16 (27.83). Standard variety performed better than other hybrid varieties, but except for RH-16, other varieties performed better than the local check variety. RH-6 was statistically at par with RH-10, RH-12, and CAH-1511. Neupane et al. (2020) found that the difference in kernel per row was due to genetic variation present in the variety.

No. of effective plants per hectare

Statistical analysis of variance revealed that the number of effective plants per hectare was statistically indifferent among the varieties (Table 5). The average number of effective plants per hectare was 62,222.22. The number of effective plants is primarily influenced by barrenness, which appeared to be similar across all varieties in this study. Favorable environmental conditions and proper agronomic practices contributed to this uniformity.

Table 4. Yield attributing characters of maize crops

Treatments	No. of effective plants/ha	Cobs/plant	Kernel rows/cob	Kernel count/row
RH-6	60370.36	1.00[b]	14.23[bc]	35.16[bc]
RH-10	61481.48	1.00[b]	14.16[c]	33.00[c]
RH-12	61481.48	1.00[b]	14.60[bc]	36.50[b]
RH-16	63333.33	1.33[a]	15.06[b]	27.83[e]
CAH-1511	60370.36	1.00[b]	14.67[bc]	34.73[bc]
Arun-2	64074.07	1.13[b]	12.93[d]	30.41[d]
Rajkumar	64074.07	1.07[b]	15.93[a]	39.47[a]
SEm(±)	1111.11	0.05	0.28	0.71
LSD	3423.674	0.17	0.86	2.20
F-test (0.05)	ns	**	***	***
CV%	3.09	9.03	3.35	3.65
Grand Mean	62222.22	1.07	14.51	33.87

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; ns: Non-significant at 5% level; **: Significant at 1% level; ***: Significant at 0.1% level; Means followed by the same letters within the column are not significantly different at 5% level by Fisher's LSD test.

Length of cob with husk

Varieties varied significantly on the length of the cob, including the husk (Table 5). Among the tested varieties, Rajkumar had the longest cob (30.16 cm), whereas RH-16 had the shortest (21.30 cm). Both check varieties performed better than the hybrid varieties in this study. RH-10 was statistically at par with RH-6, RH-12, Arun-2, and CAH-1511, while significant differences were observed with Rajkumar and RH-16. These findings agree with Neupane et al. (2020) and Yadav et al. (2024).

Length of cob without husk

The length of cob excluding husk was found to be non-significant among the varieties, with an experimental mean of 20.93 cm (Table 5). Rajkumar had the longest cob (23.28 cm), whereas RH-6 had the shortest (19.32 cm). This indicates that the husk contributes a variable and significant portion of cob length among different maize varieties (Yadav et al., 2024).

Weight of cob with and without the husk

There was a significant influence of varieties in the cob weight with or without the husk (Table 5). Including the husk, Rajkumar had the highest cob weight (301.77 g), whereas RH-16 had the lowest (208.05 g). All varieties, except RH-16, had higher unhusked cob weight than the local check variety. For husked cobs, a similar trend was observed with Rajkumar having the highest cob weight (277.16 g), whereas RH-16 had the lowest (186.16 g), and all varieties, except the RH-16, observed higher cob weights than the local check. These findings are supported by Neupane et al. (2020).

Thousand-grain weight

The weight of a thousand grains of maize was also significantly influenced by the varieties (Table 4). The weight of a thousand grains was recorded for RH-10 (353.26 g), whereas RH-12 had the lowest (260.43 g), which was even lower than the local check variety (271.48 g). RH-10 produced a higher test weight than the standard check variety in this study. RH-10 was statistically at par with CAH-1511, while significant differences were observed with Arun-2 (271.48 g), which was statistically at par with RH-6 (282.77 g), RH-12 (260.43 g), RH-16 (279.24 g), and Rajkumar (287.64 g). This significant variation in test weight is attributed to the genetic differences among the maize varieties (Bista et al., 2022; Neupane et al., 2020; Raut et al., 2017).

Table 5. Yield attributing characters of maize crops

Treatments	Cob length with husk (cm)	Cob length without husk (cm)	Cob weight with husk (g)	Cob weight without husk (g)	Test weight 12% M (g)
RH-6	26.60^{bc}	19.32^{c}	257.16^{bc}	223.39^{ab}	282.77^{b}
RH-10	25.71^{c}	21.58^{abc}	273.42^{ab}	252.40^{a}	353.26^{a}
RH-12	25.99^{bc}	20.20^{abc}	244.24^{bcd}	217.23^{ab}	260.43^{b}
RH-16	21.30^{d}	19.80^{bc}	208.05^{d}	186.16^{b}	279.24^{b}
CAH-1511	26.55^{bc}	22.77^{ab}	301.03^{a}	270.93^{a}	335.71a^{a}
Arun-2	27.75^{b}	19.56^{bc}	221.36^{cd}	195.25^{ab}	271.48^{b}
Rajkumar	30.16^{a}	23.28^{a}	301.77^{a}	277.16^{a}	287.64^{b}
SEm(±)	0.62	1.07	14.01	13.40	13.76
LSD	1.93	3.32	43.18	41.29	42.40
F-test (0.05)	***	ns	**	**	**
CV%	4.12	8.92	9.40	10.01	8.06
Grand mean	26.29	20.93	258.15	231.79	295.80

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; ns: Non-significant at 5% level; **: Significant at 1% level; ***: Significant at 0.1% level; Means sharing the same letter within a column do not differ significantly at the 5% level according to Fisher's LSD test.

Yield characters

Stover yield

The average stover produced in the experiment was 12.21 t/ha, and was found to be highly significant among the varieties (Table 6). RH-16 (14.18 t/ha) produced the highest weight of stover, while the CAH-1511 variety (10.33 t/ha) had the lowest. RH-10 (13.59 t/ha), RH-12 (13.29 t/ha) and Arun-2 (12.37 t/ha) varieties were statistically similar to the RH-16 variety but significantly higher than CAH-1511, which was statistically at par with Rajkumar (11.24 t/ha) and RH-6 (10.44 t/ha).

Biological yield

The varieties also differed significantly in the biological yield (Table 6). The highest biological yield was recorded in RH-10 (19.55 t/ha), while Arun-2 (14.32 t/ha) had the lowest biological yield. RH-10 was followed by RH-16 (18.14 t/ha) and RH-12 (17.25 t/ha) for biological yield. Overall, the hybrid cultivars had higher biological yield with respect to the local check.

Adjusted grain yield

The grain yield, which was adjusted to 12% moisture level, was also significantly affected by varieties (Table 6). CAH-1511 (7.69 t/ha) variety obtained the highest yield, while the lowest yield was observed in Arun-2 (3.83 t/ha). CAH-1511 had a significantly higher yield than RH-16 (6.53 t/ha) and Rajkumar (6.63 t/ha), which were statistically indifferent to each other. RH-12 (5.67 t/ha) and RH-6 (5.29 t/ha) had statistically lower yield but higher than that of Arun-2. The significant differences in yield are attributed to the genetic makeup of the varieties (Raut et al., 2017; Bista et al., 2022; Neupane et al., 2020).

Harvest index

The harvest index was also significantly influenced by the varieties (Table 6). CAH-1511 variety (0.46) had the highest harvest index among the evaluated varieties, whereas Arun-2 had the worst performance in terms of harvest index. After CAH-1511, the standard check variety (0.39) showed a significantly higher harvest index than the other hybrid varieties in this study.

Table 6. Yield characters of maize

Treatments	Stover yield (t/ha)	Biological yield (t/ha)	Grain yield 12%M (t/ha)	Harvest index
RH-6	10.44[bc]	15.08[e]	5.29[c]	0.35[cd]
RH-10	13.59[a]	19.55[a]	7.37[a]	0.37[bc]
RH-12	13.29[a]	17.25[c]	5.67[c]	0.32[d]
RH-16	14.18[a]	18.14[b]	6.53[b]	0.36[c]
CAH-1511	10.33[c]	16.65[d]	7.69[a]	0.46[a]
Arun-2	12.37[ab]	14.32[f]	3.83[d]	0.26[e]
Rajkumar	11.24[bc]	16.69[d]	6.63[b]	0.39[b]
SEm(±)	0.63	0.15	0.12	0.01
LSD	1.95	0.48	0.38	0.01
F-test (0.05)	**	***	***	***
CV%	8.98	1.63	3.49	4.12
Grand Mean	12.21	16.81	6.14	0.36

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; **: Significant at 1% level; ***: Significant at 0.1% level; Means sharing the same letter within a column do not differ significantly at the 5% level according to Fisher's LSD test.

Correlation Analysis

In the present study, grain yield showed strong and positive associations with major yield-attributing traits, particularly harvest index (+0.90), biological yield (+0.74), thousand-grain weight (+0.63), kernel rows per cob (+0.57), cob weight without husk (+0.57), and cob length without husk (+0.55), as illustrated in Fig. 1. These relationships indicate that grain yield in maize is largely governed by sink capacity and overall biomass production, with harvest index and biological yield playing a central role in assimilate production and partitioning toward economic yield (Gound et al., 2025; Hütsch & Schubert, 2017).

In contrast, phenological traits such as days to 50% tasseling (+0.18) and days to 50% silking (+0.12) showed weak and non-significant correlations with grain yield, suggesting limited direct influence of flowering time on yield variation under the present conditions. This indicates that yield differences among genotypes were mainly determined by yield components rather than phenological duration (Gound et al., 2025).

Plant height exhibited a significant negative correlation with days to 50% tasseling (-0.59) and silking (-0.65), indicating that taller plants tended to flower earlier, whereas delayed flowering was associated with relatively shorter plants (Jakhad et al., 2025).

Overall, these findings suggest that yield improvement in maize is primarily associated with biomass accumulation and yield component traits rather than phenological traits (Gound et al., 2025; Hütsch & Schubert, 2017). These results are in agreement with previous studies reporting similar relationships (Kandel et al., 2018; Kandel & Shrestha, 2020; Raut et al., 2017; Sharma et al., 2018; Wannows et al., 2010).

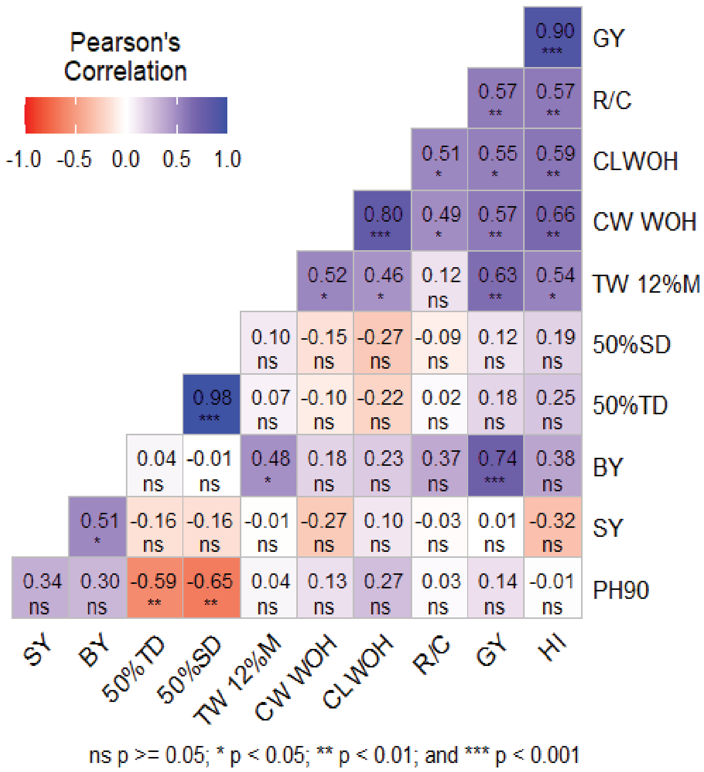

Fig. 2. Correlation analysis among various parameters of maize

Note. GY: Grain yield; R/C: Kernel rows per cob; CL WOH: Length of cob without husk; CW WOH: Weight of cob without husk; TW 12%M: Thousand-grain weight; 50%SD: Days to 50% silking; 50%TD: Days to 50% tasseling; BU: Biological yield; SY: Stover yield; PH90: Plant height after 90 DAS; HI: Harvest index

Economic Analysis

The economics of various varieties evaluated in the study are presented in Table 7.

Cost of cultivation

CAH-1511 (149,200 NPR/ha) had the highest cost for cultivation, while the lowest cost of production was recorded for Arun-2 (141,700 NPR/ha).

Gross and net returns

The varieties differed significantly in gross and net returns from the production. The CAH-1511 variety provided the highest gross and net returns, which were statistically at par with RH-10.

B:C ratio

The B:C ratio responded significantly to different varieties. RH-10 had the highest return per unit of cost, which was at par with CAH-1511. Arun-2 had the lowest B:C ratio.

Table 7. Total cost of cultivation, gross return, net return and benefit cost ratio of maize production in one hectare as influenced by variety on field experiment in Kailali, Kailali.

Variety	Cost of cultivation (NPR)	Gross income (NPR)	Net income (NPR)	B:C ratio
RH-6	144,200[c]	206036.7[d]	61836.67[d]	1.43[d]
RH-10	146,700[b]	285376.7[a]	138676.67[a]	1.95[a]
RH-12	144,200[c]	224926.7[c]	80726.67[c]	1.56[c]
RH-16	146,700[b]	257040.0[b]	110340.00[b]	1.75[b]
CAH-1511	149,200[a]	290050[a]	140850.00[a]	1.94[a]
Arun-2	141,700[d]	177946.7[e]	36246.67[e]	1.26[e]
Rajkumar	144,200[c]	254543.3[b]	110343.33[b]	1.77[b]
SEm	0.00	5008.36	5008.36	0.0343
LSD	1.832261e-11	15432.31	15432.31	0.11
F-test	***	***	***	***
CV%	7.089783e-15	3.58	8.94	3.57
Grand mean	145271.4	242274.3	97002.86	1.66

Note. SEm (±): Standard error of mean; LSD: Least significant difference; CV: Coefficient of variation; ***: Significant at 0.1% level; Means sharing the same letter within a column do not differ significantly at the 5% level according to Fisher's LSD test.

CONCLUSION

This study confirms the significant role of maize varieties in enhancing growth, stover yield, and grain yield. Hybrid varieties had better performance when it comes to yield-attributing characteristics compared to OPV. Based on overall agronomic performance, grain yield, and economic returns, CAH-1511 and RH-10 were identified as the most suitable varieties for cultivation under the studied conditions. These findings provide useful evidence for varietal selection to enhance spring maize productivity in the western Terai.

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AUTHOR CONTRIBUTIONS

KB: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft; **BBA:** Writing – review & editing, Supervision; **HJ:** Methodology, Investigation, Writing – original draft; **AB:** Writing – original draft.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICAL APPROVAL AND PERMITS

This study involved field trials of officially released maize varieties. This experiment did not involve any human participants, animals, or protected species, and therefore, no ethical approval or permits were required.

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