Table 2: Effect of Varieties and Nutrient Management Practices on The Aboveground Dry Matter at Different Growth Stages of Maize During Winter, 2018/19 at Khairahani-5, Chitwan

Factors	Dry Matter Accumulation (g plant^{-1})						
	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS
Varieties							
RC	4.106	11.75^{a}	24.66	40.83	63.11^{a}	111.99	159.49
RH-6	3.345	7.31^{b}	16.68	29.54	44.73^{b}	115.90	180.49
SEm±	2.512	5.119	44.34	91.17	78.69	177.55	422.16
LSD_a (0.05)	2.783	3.974	11.69	16.77	15.58	23.40	36.09
CV(a)%	42.5%	23.7%	32.2%	27.13	16.45%	11.69	12.08
F-test	NS	*	NS	NS	*	NS	NS
NM Practices							
BR	3.42	9.90	20.10	32.46	47.54	97.61	144.66^{b}
NE	3.67	10.55	21.17	37.07	55.59	129.77	197.63^{a}
FFP	3.63	8.37	20.93	34.30	54.40	106.57	155.50^{b}
LCC(N) & NE(PK)	4.18	9.31	20.48	36.90	58.13	121.83	182.07^{ab}
SEm±	3.545	13.19	36.65	93.81	316.71	719.33	1092.21
LSD_b (0.05)	2.368	4.56	7.616	12.81	22.38	33.73	39.57
CV(b)%	50.5%	38.09%	29.28%	27.52%	33.00	23.53	19.44
F-test	NS	NS	NS	NS	NS	NS	*
Interaction							
F-test	NS	NS	NS	NS	NS	NS	NS
Grand Mean	3.726	9.535	20.67	35.18	105.67	113.94	169.96

Mean followed by common letter(s) within each column are not significantly different ($p<0.05$) by LSD; NS= non-significant, * = significantly different, SEm= Standard Error Mean, LSD=Least Significant Difference, CV= Coefficient of Variation

The difference among the varieties for dry matter production was noticed. Initially, the dry matter production of Rampur Hybrid-6 was less than the Rampur Composite till 90 DAS, but after that, dry matter was found to be more for Rampur Hybrid-6. This may be due to the more responsive nature of hybrid varieties to the added nutrients to the soil. Also, the number of cobs in the case of hybrid varieties was seen more as compared to the OPV, which increases the dry matter production as the reproductive phase begins. The hybrid cultivar had a strong and thick stem with good root coverage. One of the most important factors for higher dry matter production by hybrid is its good source-sink relationship.

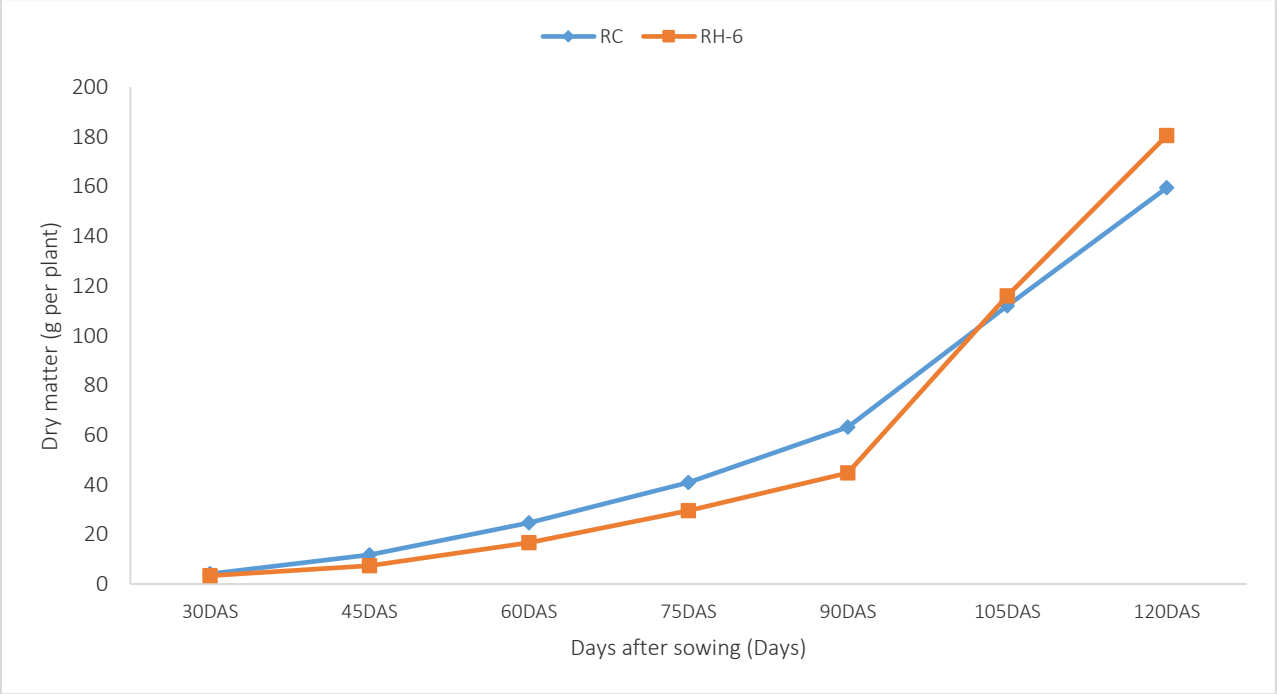

Figure 2: Effect of Varieties on Dry Matter Production of Maize

The dry matter production (g plant^{-1}) increased as the growth progressed, maximum at 120 DAS. Among the nutrient management practices, site-specific nutrient management (NE) recorded higher dry weight (g plant^{-1}) over the blanket recommended dose of fertilizer and farmer fertilizer practice dose. At the initial stages, site-specific nutrient management based on NE-Maize and LCC was comparable to FFP and BR dose of fertilizers but was significantly different at the later stages. However, site-specific nutrient management practices based on NE and LCC (N) proved their distinct superiority over farmer fertilizer practices in respect of dry matter accumulation. This result is similar with the finding of (Raj et al., 2018). The dry matter production is the total sum effect of overall growth. Site-specific nutrient management (NE) had a higher leaf area index indicating a higher chlorophilic area, thus improving the photosynthetic efficiency of plant, resulting in higher dry matter accumulation.

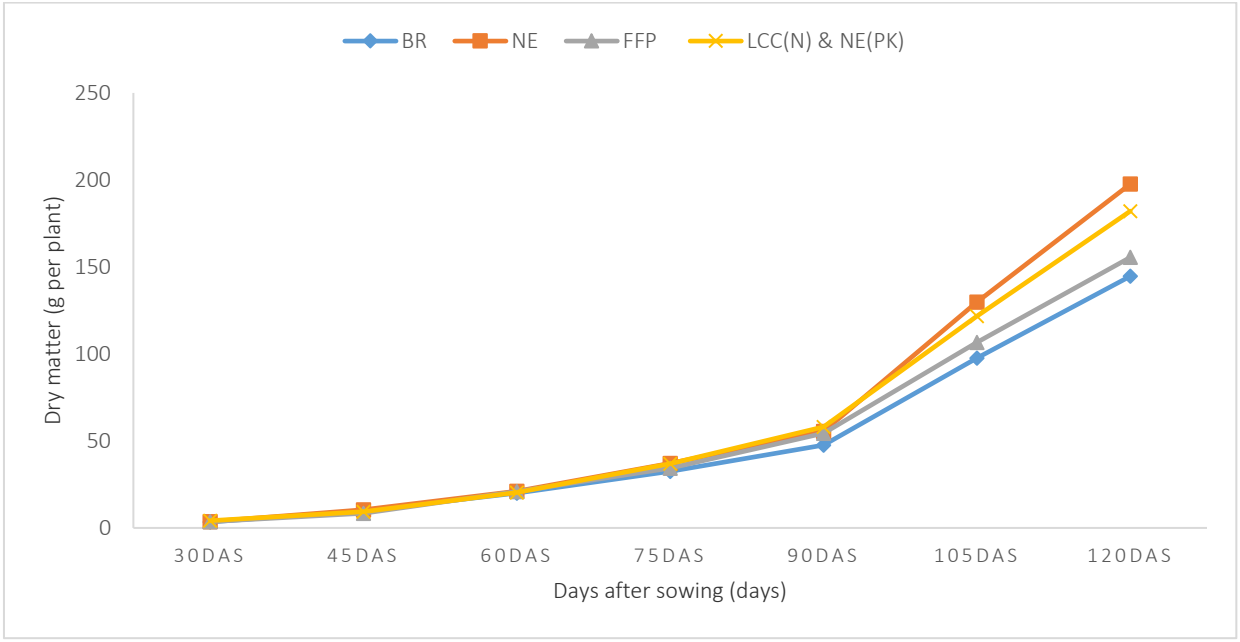

Figure 3: Effect of nutrient management practice on dry matter production of maize

3.3 Leaf Area Index (LAI)

Varieties exhibited mean LAI significantly ($p<0.05$) different at 90 DAS but comparable with other varieties in all the remaining growth stages (30, 45, 60, 75, 105, 120 DAS). LAI of the Rampur composite variety was found to be higher than that of Rampur Hybrid-6 in all growth stages except at 120 DAS, but LAI of both varieties is statistically at par in all growth stages. The highest LAI was found to be at 120 DAS for both Rampur composite (2.801) and Rampur hybrid-6 (3.330) varieties. There is no any significant difference in LAI due to the nutrient management practices in all growth stages, but the highest LAI was obtained for LCC(N) dose (3.393), followed by NE (3.191) and BR (2.857) at 120 DAS. But at 90 DAS, LAI for NE (2.975) was found to be higher than that of LCC (N) (2.583) and FFP (2.450). The LAI of both the varieties for all nutrient management practices was increased continuously from 30 DAS to 120 DAS, but after that, LAI dropped sharply at the time of harvest. The interaction effect of varieties and nutrient management practice was found to be non-significant at all growth stages.

Table 3: Effect of Varieties and Nutrient Management Practices on The Leaf Area Indices (LAI) at Different Growth Stages of Maize During Winter, 2018/19 at Khairahani-5, Chitwan

Factors	Leaf Area Index (LAI)							
	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS	At harvest
Varieties								
RC	0.475	0.496	0.770	1.230	2.054[a]	2.679	2.801	1.355
RH-6	0.279	0.360	0.596	0.868	1.717[b]	2.520	3.330	1.181
SEm±	0.018	0.014	0.058	0.068	0.035	0.645	0.274	0.016
LSD_a (0.05)	0.235	0.210	0.423	0.457	0.329	1.411	0.659	0.223
CV(a)%	35.5%	27.91%	35.27%	24.80%	9.95%	30.89%	17.1%	10.01%
F-test	NS	NS	NS	NS	*	NS	NS	NS
NM Practices								
BR	0.379	0.411	0.712	1.224	1.863	2.390	2.857	1.161
NE	0.389	0.396	0.654	0.931	1.809	2.975	3.191	1.303
FFP	0.419	0.511	0.735	1.021	1.964	2.450	2.816	1.152
LCC(N) & NE(PK)	0.321	0.393	0.633	1.022	1.903	2.583	3.393	1.456
SEm±	0.016	0.011	0.018	0.179	0.342	0.265	0.274	0.038
LSD_b (0.05)	0.160	0.134	0.169	0.533	0.736	0.647	0.659	0.246
CV(b)%	33.8%	24.88%	19.61%	40.34%	31.03%	19.78%	17.09%	15.43%
F-test	NS	NS	NS	NS	NS	NS	NS	NS
Interaction								
F-test	NS	NS	NS	NS	NS	NS	NS	NS
Grand Mean	0.377	0.428	0.683	1.049	1.885	2.599	3.064	1.268

Mean followed by common letter(s) within each column are not significantly different ($p<0.05$) by LSD; NS= non-significant, * = significantly different, SEm= Standard Error Mean, LSD=Least Significant Difference, CV= Coefficient of Variation

Hybrids are higher yielders, so they need to develop higher LAI as leaves are the kitchen of the plant body, from where supplements are transported for other structural formations. Initially, the genetic factor played a major role in increasing leaf area, but after the crop nutrient demand for making reproductive parts was increased, hybrids increased their leaf area to a more nutrient-demanding nature for making edible parts. Thus, the LAI of the Rampur composite variety was recorded more, but as the crop proceeds towards the reproductive stage, the LAI of Rampur hybrid-6 recorded significantly higher LAI.

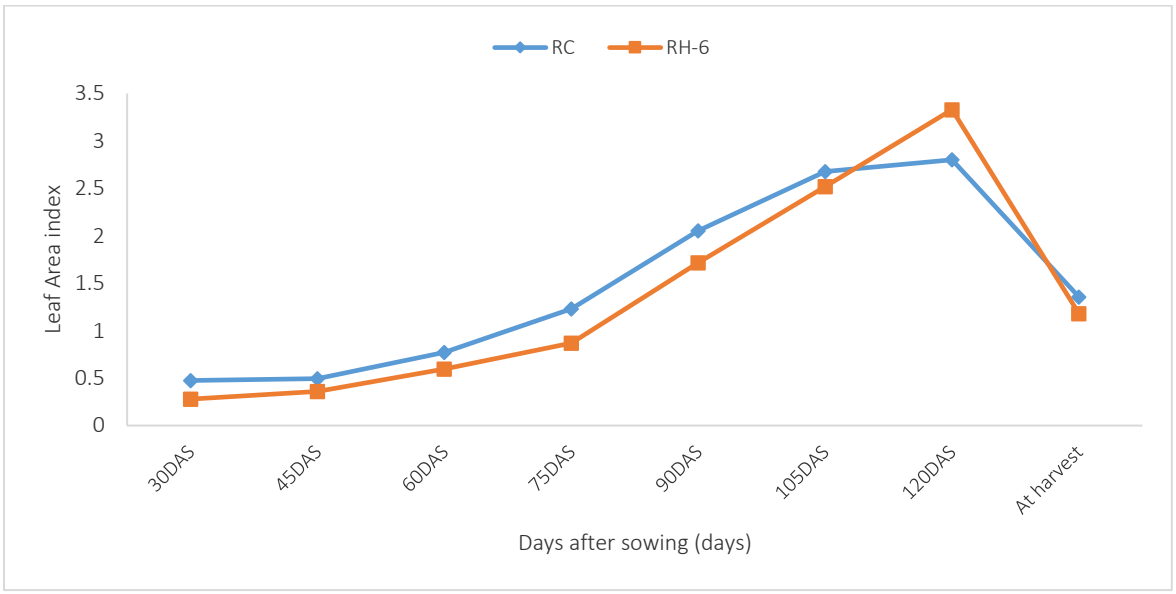

Figure 4: Effect of Varieties on Leaf Area Index of Maize

The leaf area index increased successively as the growth progressed up to 120 DAS. Site-specific nutrient management based on Nutrient Expert (NE) dose and LCC (N) had a higher leaf area index than the blanket recommended dose of fertilizer and farmers' fertilizer practice at 120 DAS as in figure 5. Higher leaf area under site-specific nutrient management has also been reported (Mashego, 2013). When the resources are suboptimal, the leaf growth rate and thus the leaf area index can be limited by the low rate of net photosynthesis or insufficient cell expansion, resulting in a lower leaf area index under farmer's fertilizer practice as site-specific nutrient management had better nutrient supplying capacity as per crop need, resulting in higher leaf growth rate and thereby higher leaf area index.

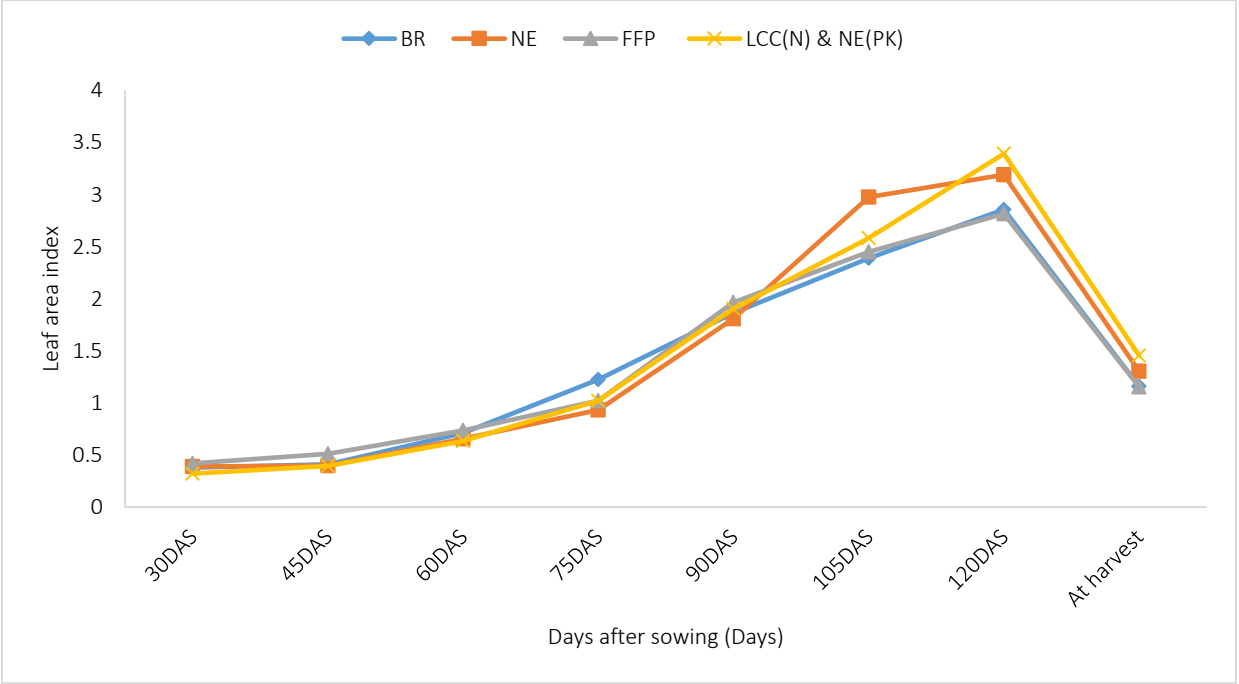

Figure 5: Effect of Nutrient Management Practices on Leaf Area Index of Maize

3.4 Effect on Yield, Yield Attributes, and Production Economics

Table 4 indicates that the number of kernel rows ear^{-1} was found to be non-significantly different among varieties but significantly different due to nutrient management practices. LCC (N) had a significantly higher number of rows ear^{-1} (13.000) than BR (12.067) but was statistically at par with FFP (12.600) and NE (12.533). The highest number of kernels row^{-1} was found to be for NE (25.533), which is statistically at par with LCC (N) (24.833) but significantly different from FFP (22.833) and BR (22.600). The higher number of kernel rows ear^{-1} in LCC (N) may be due to the better grain filling due to the split application of Nitrogen, producing a better source-sink relationship during reproductive stages. The enhanced nutrient availability under site-specific nutrient management led to increased leaf area, photosynthesis, etc. This resulted in the formation of healthy cobs and a higher number of kernels ear^{-1}. In the cultivars, Rampur Hybrid-6 has a greater number of rows ear^{-1} (12.73) and a number of kernels row^{-1}(24.21) than Rampur Composite. The reason for best performance for most of the traits in hybrid might be due to added traits called heterosis.

Thousand-grain weight was found to be highest for NE (357.747), followed by LCC (N) (342.001) and FFP (341.178) but the statistically non-significant difference with all other treatments. The lowest thousand-grain weight was found to be for BR (326.315). The better LAI AGDM during reproductive stages may contribute to better source-sink capacity and help to produce bold and plump seeds. This, in turn, increases the test weight in case of NE dose and LCC (N) dose than a blanket recommendation Grain and stover yields had shown non-significant ($p<0.05$) differences for the two maize varieties. Rampur hybrid-6 had a greater grain yield (5.877 t ha^{-1}) and stover yield (7.636 t ha^{-1}) than the Rampur composite in both grain (5.252 t ha^{-1}) and stover (6.893 t ha^{-1}) yield. This is because OPV maize is less genetic potential than hybrid maize varieties.

The grain yield and stover yield were found to be highly significantly different for four nutrient management practices. The highest grain and

stover yield was recorded for NE recommendation (6.399 t ha^{-1} and 9.279 t $ha^{-1,}$ respectively), followed by LCC(N) (6.071 t ha^{-1} and 7.246 t $ha^{-1,}$ respectively). BR had the lowest grain yield (4.482 t ha^{-1}), but in the case of stover yield, FFP recommendation had recorded the lowest stover yield (5.890 t ha^{-1}). This may be due to the proper application of the fertilizers by evaluating the crop nutrient need, and initial soil fertility status is also considered while estimating the dose in NE. The LCC (N) dose based on the leaf greenness also gave a higher yield because it provided the Nitrogen according to the crop needs at the proper time.

Due to varieties, HI and GSR showed non-significant ($p<0.05$) differences. The HI of Rampur hybrid-6 (0.438) was found to be comparable with Rampur composite (0.436). Also, the GSR of Rampur hybrid-6 (0.789) was found to be nearly equal to that of Rampur composite (0.786). Unlike above, HI and GSR were found to be significantly different among nutrient management practices. HI, and GSR of FFP recommendation was found to be highest (0.479 and 0.931 respectively), followed by LCC (N) (0.456 and 0.843 respectively) and NE recommendation (0.410 and 0.699 respectively). The lowest HI and GSR were obtained in BR (0.403 and 0.677, respectively).

Harvest index was found nearly equal for both the varieties, and they were statistically at par. FFP has the highest harvest index, followed by LCC (N) and NE. The insect damage was seen more on the FFP plots, due to which most of the biomass was destroyed after the reproductive parts were formed. This plot's leaves were pale yellow due to the field's water stagnation area, which may decrease the biomass, resulting in higher HI. The BC ratio was also found to be highest for NE (2.47), followed by LCC (N) (2.42) and FFP (2.17). The lowest BC ratio was found to be for BR (1.81). And the BC ratio for Rampur hybrid-6 (2.23) than Rampur composite (2.21) variety. Thus the best nutrient management practice that benefits the farmer was NE.

Table 4: Effect of Varieties and Nutrient Management Practices on Yield Attributing Character, Yield, and Harvest Index of Maize During The Winter Season, 2018/19 at Khairahani-5, Chitwan

Factors	Number Of Rows Ear^{-1}	Number Of Kernels Row^{-1}	Thousand Grain Weight (G)	Grain Yield (T Ha^{-1})	Stover Yield (T Ha^{-1})	Harvest Index	Grain Stover Ratio	Benefit-Cost Ratio
Varieties								
Rc	12.367	23.683	351.64	5.252	6.893	0.436	0.786	2.21
RH-6	12.733	24.217	331.98	5.877	7.636	0.438	0.789	2.23
SEm±	0.187	2.112	2168.12	0.922	3.484	0.001	0.012	0.050
LSD (0.05)	0.759	2.553	81.790	1.687	3.279	0.056	0.189	0.394
CV%	3.4%	6.1%	13.6%	17.3%	25.7%	7.2%	13.7%	10.1%
F-test	NS	NS	NS	NS	NS	NS	NS	NS
NM PRACTICES								
BR	12.067^{b}	22.600^{b}	326.315	4.482^{c}	6.644^{b}	0.403^{c}	0.677^{c}	1.81^{c}
NE	12.533^{ab}	25.533^{a}	357.747	6.399^{a}	9.279^{a}	0.410^{bc}	0.699^{bc}	2.47^{a}
FFP	12.600^{ab}	22.833^{b}	341.178	5.307^{bc}	5.890^{b}	0.479^{a}	0.931^{a}	2.17^{b}
LCC(N) & NE (PK)	13.000^{a}	24.833^{a}	342.001	6.071^{ab}	7.246^{b}	0.456^{ab}	0.843^{ab}	2.42^{a}
SEm±	0.249	1.909	1401.21	0.556	1.857	0.001	0.016	0.036
LSD (0.05)	0.628	1.738	47.088	0.938	1.714	0.048	0.159	0.239
CV%	4%	5.8%	11%	13.4%	18.8%	8.6%	16.1%	8.6%
F-Test	*	**	NS	**	**	*	*	***
Interaction								
F-Test	NS	NS	NS	NS	NS	NS	NS	NS
Grand Mean	12.55	23.95	341.81	5.565	7.264	0.437	0.788	2.22

Note: * Significant at 0.05 level of significance, ** Significant at 0.01 level of significance, *** Significant at 0.001 level of significance. Means followed by the same letter(s) in the same column are not significantly different at a 0.05 level of significance by DMRT.

4. Conclusion

Cultivating maize in the winter season with both Rampur hybrid-6 and Rampur composite varieties is a perfect option for farmers of the central Terai region if site-specific nutrient management practices are adopted. This research found that adopting NE-based recommendations for nutrient management helps to get maximum yield with maximum profit for both the varieties during the winter season in Khairahani, Chitwan. In all nutrient management practices used in the research, the yield of the hybrid variety was slightly more than the composite variety. So we can conclude that nutrient management practice is a major contributor to increasing the yield in case of both the varieties used in research. The study shows the profitability of SSNM (Nutrient Expert) over the blanket recommendation and farmers' nutrient management practices. Thus, site-specific nutrient management based on NE-Maize software should further be researched in different regions to disseminate this nutrient management technique fully.

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