Biological Forum – An International Journal 15(4): 29-32(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Studies on Influence of Site Specific Nutrient Management based on Target Yield during different Growth Stages of Cabbage (*Brassica oleracea* var. *capitata* L.)

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(Received: 09 February 2023; Revised: 26 February 2023; Accepted: 05 March 2023; Published: 20 April 2023)
(Published by Research Trend)

ABSTRACT: The current fertiliser recommendations for cabbage frequently include fixed rates and timing of N, P, and K, over the years, such advice has remained consistent across a wide range of sectors. However, crop growing circumstances, crop and soil management, and climate, which can vary widely from field to field, season to season, and year to year, all have a significant impact on crop growth and the need for additional nutrients. It is not a primary goal of the SSNM (site specific nutrient management) approach to decrease or increase fertiliser use. Instead, it seeks to apply nutrients at the best possible rates and times in order to increase crop production and nutrient usage efficiency, which will result in a high monetary value of the harvest for each unit of fertiliser used. Sustainable agricultural management technologies should be studied in terms of increased productivity, profitability, energy saving and efficiency of agricultural inputs usage by using efficiency indices and sustainable. Field experiment was conducted at College of Horticulture, Bidar, during *rabi* seasons for two consecutive years (2020 and 2021) The experiment was laid out in randomized block design with three replications. The experimental results revealed that the significantly higher plant height (34.82 cm) was recorded with target yield of 40.0 tha^{-1} which was on par with target yield of 35.0 t ha^{-1} (32.56 cm). While significantly lower plant height was recorded with farmer's practice (25.01 cm). significantly higher plant spread was recorded with target yield of 40.0 t ha^{-1}(38.62 cm) followed by target yield of 35.0 t ha^{-1} (35.76 cm) as compared to rest of the treatments and significantly lower plant spread was noticed with farmer's practice (29.75 cm), significantly higher leaf area index was noticed with target yield of 40.0 t ha^{-1} (0.48) when compared to rest of the target yield treatments.

Keywords: Site specific nutrient management, Target yield and Growth parameters.

INTRODUCTION

One of the most significant species in the genus Brassica is cabbage (*Brassica oleracea* var. *capitata* L.). In terms of area, production and availability, it is a widely used vegetable virtually through the year. It is mostly grown in India during the *rabi* season. Cabbage is the earliest cole crop to be grown and it is believed to be originated in Western Europe. Before it was grown and utilized for food, it was originally used for medicinal purposes earlier to cultivation and use as food (Silva, 2010). Through mutation and introgression from wild species, human selection, and adaption, it has evolved from a single wild ancestor (*Brassica oleracea* L. var. *sylvestris*), also known as wild cabbage, cliff cabbage, or "Colewort." Due to its excellent flavour, nutritious value, and extremely low fat and calorie content, it holds the top spot among cole crops. It is cultivated for its heads, which are harvested for use as vegetables, eaten raw, and frequently preserved as pickles or sauerkraut. Additionally, it is cooked and combined with potatoes for a salad, though more raw than processed. Minerals and vitamins including A, B, and C are abundant in cabbage head. Half a cup of cooked cabbage is thought to contain roughly a third of the daily recommended amount of vitamin C. It provides fiber, folic acid, potassium, magnesium, vitamin K. cabbage ferments naturally to produce probiotics that feed the gut flora. These microorganisms aid in digestion, immunity, vitamin absorption, and anxiety regulation in our body. According to reports, 100 g of green edible cabbage contains 92% water, 18 mg of sodium, 170 mg of potassium, 1.28 g of protein, 5.8 g of carbohydrates, 4 per cent of calcium and 2 per cent of iron (Yadav, 2000).

The SSNM (site specific nutrient management) approach does not significantly aim to either reduce or increase fertilizer use. Instead, it aims to apply nutrients at optimal rates and times in order to achieve high yield and high efficiency of nutrient use by the crop, leading to high cash value of the harvest per unit of fertilizer invested (Shankar and Umesh 2008). Considering the fertilizer cost and availability, this limited resource needs to be saved for sustainable crop production through improving the nutrient use efficiency by site specific application. Sustainable agricultural management technologies should be studied in terms of increased productivity, profitability, energy saving and efficiency of agricultural inputs usage by using efficiency indices and sustainable of crop production systems in agriculture. The practise of feeding crops nutrients as and when they require them is known as site-specific nutrient management. In order to achieve the desired yield, the application and management of nutrients are constantly adjusted to the crop needs of the region and season. Keeping all these views, investigation has been planned with a title Studies on influence of site specific nutrient management based on target yield during different growth stages of cabbage (*Brassica oleracea* var. *capitata* L.).

MATERIALS AND METHODS

The experiment was conduct at College of Horticulture, Bidar as part of Ph.D. research work to study the influence of site specific nutrient management based on target yield during different growth stages of cabbage in north eastern transitional zone of Karnataka during *rabi* seasons of 2020 and 2021. Survey was conducted in surrounding villages of experimental site with 25 farmers growing cabbage for their nutrient management. Based on their nutrient management practices, average quantity of fertilizers for farmer's practice treatment was worked out. The amount of fertilizer for SSNM treatments was calculated by using the formulae (IPNI web site).

FA = Nutrient uptake by crop per tonne grain yield × T

Where,

T = Targeted yield (t ha^{-1}).

The composite soil samples from each treatment at 0-15 cm depth was collected and analyzed before the initiation of experiment during *rabi* seasons of 2020 and 2021. The nutrient statuses of soils are mentioned in the Table 1. Nutrient removal by cabbage crop per tonne head yield were 3.9, 0.9, 3.6 NPK kg ha^{-1} respectively (IPNI website) (Doberman *et al*., 2004). The nutrient ratings for soil available nutrient status are as below.

Nutrient rating	Quantity to be applied
Medium	Exactly removal quantity
Low	30% more
High	30% less

The calculated fertilizer doses for different target yield of cabbage are given in the Table 1. 50% of nitrogen through urea and entire quantity of phosphorus through DAP (Diammonium phosphate) and potassium through MOP (Murate of potash) were supplied at the time of planting as a basal dose to each plot and remaining 50 per cent of nitrogen was applied at 30 days after planting. The soil samples were analyzed by adopting standard procedures (Nitrogen - Subbaiah and Asija method (1956), Phosphorus - Olsen *et al.* (1954); Potassium - Jackson (1973).

RESULTS AND DISCUSSION

Plant height of cabbage differed significantly due to different target yield levels during both the years of experimentation and in their pooled data at all the growth stages except 30 DAT.

Among the different target yield levels, significantly higher plant height (29.10 cm) was recorded with target yield of 40.0 t ha^{-1} but it was on par with target yield of 35.0 t ha^{-1} (27.66 cm) and significantly lower plant height was recorded with farmer's practice (21.13 cm) in pooled mean at 60 DAT. At harvest, pooled mean indicated that significantly higher plant height (34.82 cm) was recorded with target yield of 40.0 tha^{-1} which was on par with target yield of 35.0 t ha^{-1} (32.56 cm).

While significantly lower plant height was recorded with farmer's practice (25.01 cm).Similar trend was noticed during the years 2020 and 2021. Different target yield levels had influence on plant spread significantly at 60 DAT and at harvest except at 30 DAT. At 60 DAT, significantly higher plant spread was recorded with target yield of 40.0 t ha^{-1}(38.62 cm) followed by target yield of 35.0 t ha^{-1} (35.76 cm) as compared to rest of the treatments and significantly lower plant spread was noticed with farmer's practice (29.75 cm) in the pooled mean. At harvest, plant spread was higher with target yield of 40.0 t ha^{-1} (43.17 cm) which was found be on par with target yield of 35.0 t ha^{-1} (40.78 cm). While significantly lower plant spread (34.04 cm) was noticed in farmer's practice treatment in their pooled data These results are in conformity with the findings of Mauriya *et al.* (2013); Honnalli and Chittapur (2014); Jain *et al.* (2015); Shreeharshakumar and Gaddanakeri (2015); Anand *et al*. (2022).

The leaf area indicates the photosynthetic area available for synthesis of food. Higher the leaf area assimilates higher is the dry matter thus increasing the growth attributes like plant height and inturn higher source to sink relationship. In the present investigation, leaf area increased from 30 to 60 DAT (Table 4). At 60 DAT, the pooled data revealed that the target yield of 40.0 t ha^{-1} (864.19 cm^2 $plant^{-1}$) significantly higher over farmer's practice (724.23 cm^2 $plant^{-1}$). Significant variations were observed with respect to leaf area index at 60 DAT due to different target yield levels. In general, the leaf area index increased from 30 DAT and reached maximum at 60 DAT. The trend of variation in leaf area index was obviously similar to that of leaf area $plant^{-1}$. Among the different target yield levels at 60 DAT, significantly higher leaf area index was noticed with target yield of 40.0 t ha^{-1} (0.48) when compared to rest of the target yield treatments, but it was on par with target yield of 35.0 t ha^{-1} (0.47) and significantly lower leaf area index was recorded with farmer's practice (0.40) in their pooled mean. The nutrient might have played a potent role on enhanced cell division and elongation of leaves resulting in higher biomass. Better crop growth in this treatment might have lead to the production of higher number of leaves and inturn the enhanced leaf area. Besides higher accumulation of dry matter in leaves might have helped the photosynthetic area to remain active for longer period and was responsible for overall growth of plants in terms of dry matter production. Further, this has resulted in increased leaf area index which is indicative of high mobilizable protein pools available at the beginning of the reproductive phase and later on greater plant bearing capacity. Similar results have been reported by Kumar *et al*. (2014); Prasad *et al*. (2016); Suri and Sarita (1996).

Table 1: The calculated fertilizer dose for different targeted yield for cabbage during *rabi*, 2020 and 2021.

Sr. No.	Treatment	N	P	K
		kg ha^{-1}		
1.	Target yield of 25 t ha^{-1}	126.75	22.50	63.00
2.	Target yield of 30 t ha^{-1}	152.1	27.00	75.60
3.	Target yield of 35 t ha^{-1}	177.45	31.50	88.20
4.	Target yield of 40 t ha^{-1}	202.8	36.00	100.80
5.	Target yield of 45 t ha^{-1}	228.15	40.50	113.40
6.	RDF	150.00	100.00	125.00
7.	Farmer's practice	90.00	39.00	60.00

Table 2: Plant height of cabbage at different growth stages as influenced by site specific nutrient management.

Treatment	Plant height (cm)								
	30 DAP			60 DAP			At harvest		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Target yield of 25 t ha^{-1}	15.33	15.38	15.36	24.99	25.32	25.15	28.80	29.20	29.00
Target yield of 30 t ha^{-1}	15.97	16.02	16.00	26.47	26.79	26.63	31.50	31.90	31.70
Target yield of 35 t ha^{-1}	16.16	16.22	16.19	27.48	27.83	27.66	32.11	33.01	32.56
Target yield of 40 t ha^{-1}	16.94	17.00	16.97	28.91	29.28	29.10	34.59	35.05	34.82
Target yield of 45 t ha^{-1}	16.95	17.01	16.98	26.28	26.62	26.45	31.28	31.98	31.63
RDF	15.82	15.88	15.85	25.10	25.43	25.27	28.92	29.30	29.11
Farmer's practice	14.82	14.87	14.84	21.18	21.23	21.13	24.84	25.18	25.01
Mean	**16.00**	**16.05**	**16.03**	**25.77**	**26.07**	**25.91**	**30.29**	**30.80**	**30.55**
S.Em.±	**0.74**	**0.75**	**0.74**	**0.75**	**0.83**	**0.82**	**0.89**	**0.79**	**0.83**
C.D. at 5%	**NS**	**NS**	**NS**	**2.31**	**2.55**	**2.53**	**2.73**	**2.44**	**2.57**

NS – Non significant

Table 3: Plant spread of cabbage at different growth stages as influenced by site specific nutrient management.

Treatment	Plant spread (cm^2)								
	30 DAP			60 DAP			At harvest		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Target yield of 25 t ha^{-1}	27.82	28.07	27.95	31.40	32.76	32.08	36.26	37.01	36.64
Target yield of 30 t ha^{-1}	27.86	28.32	28.09	32.94	34.35	33.64	37.53	38.29	37.91
Target yield of 35 t ha^{-1}	28.83	29.30	29.07	35.05	36.46	35.76	40.38	41.19	40.78
Target yield of 40 t ha^{-1}	29.79	30.27	30.03	37.89	39.35	38.62	42.75	43.60	43.17
Target yield of 45 t ha^{-1}	28.91	29.38	29.15	33.35	34.73	34.04	38.05	38.83	38.44
RDF	27.11	27.72	27.41	31.75	32.93	32.34	36.61	37.32	36.96
Farmer's practice	27.35	26.88	27.12	29.22	30.27	29.75	33.72	34.36	34.04
Mean	**28.24**	**28.56**	**28.40**	**33.09**	**34.41**	**33.75**	**37.90**	**38.66**	**38.28**
S.Em.±	**1.52**	**1.96**	**1.73**	**1.24**	**1.32**	**1.28**	**1.31**	**1.34**	**1.33**
C.D. at 5%	**NS**	**NS**	**NS**	**3.82**	**4.07**	**3.94**	**4.03**	**4.14**	**4.09**

NS – Non significant

Table 4: Leaf area and leaf index of cabbage at different growth stages as influenced by site specific nutrient management.

Treatment	Leaf area (cm^2 plant^{-1})						Leaf area index					
	30 DAP			60 DAP			30 DAP			60 DAP		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Target yield of 25 t ha^{-1}	581.67	605.28	593.48	781.92	787.12	784.52	0.323	0.336	0.330	0.434	0.437	0.436
Target yield of 30 t ha^{-1}	579.00	602.66	590.83	789.19	794.42	791.80	0.322	0.335	0.328	0.438	0.441	0.440
Target yield of 35 t ha^{-1}	586.33	610.40	598.37	844.67	850.31	847.49	0.326	0.339	0.332	0.469	0.472	0.471
Target yield of 40 t ha^{-1}	588.00	611.18	599.59	861.33	867.05	864.19	0.327	0.340	0.333	0.479	0.482	0.480
Target yield of 45 t ha^{-1}	584.67	608.03	596.35	811.97	817.35	814.66	0.325	0.338	0.331	0.451	0.454	0.453
RDF	576.12	598.77	587.44	784.08	789.32	786.70	0.320	0.333	0.326	0.436	0.439	0.437
Farmer's practice	543.33	564.68	554.01	721.71	726.76	724.23	0.302	0.314	0.308	0.401	0.404	0.402
Mean	**577.02**	**600.14**	**588.58**	**799.27**	**804.62**	**801.94**	**0.321**	**0.333**	**0.327**	**0.444**	**0.447**	**0.446**
S.Em.±	**28.84**	**28.97**	**28.90**	**23.17**	**23.43**	**23.30**	**0.020**	**0.020**	**0.020**	**0.01**	**0.01**	**0.01**
C.D. at 5%	**NS**	**NS**	**NS**	**71.39**	**72.20**	**71.79**	**NS**	**NS**	**NS**	**0.040**	**0.040**	**0.040**

NS – Non significant

CONCLUSIONS

Any genuine innovation is rendered useless, if it has no practical utility. The adaptation of technology by farmer's being the main objective; a technology can be more easily adopted, if the farming community is convinced about its benefits. The results obtained in the present investigation revealed target yield of 40.0 t ha^{-1} followed by target yield of 35.0 t ha^{-1} are found to be most promising treatments for growth traits.

Acknowledgement. It is very difficult to express one's feelings in words but formality demands to do so the extent possible. I feel the inadequacy of diction in expressing my sincere heartfelt gratitude to my advisory committee and Dean College of Horticulture, Bidar for providing all the facilities during my research.

Conflict of Interest. None.

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How to cite this article: Imamsaheb S.J., Raveendra S.J., Hanchinamani C.N., Patil A.G., Basavarajappa M.P., Mallikarjun Awati and Sanjeevraddi G.R. (2023). Studies on Influence of Site Specific Nutrient Management based on Target Yield during Different Growth Stages of Cabbage (*Brassica oleracea* var. *capitata* L.). *Biological Forum – An International Journal, 15*(4): 29-32.