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Effect on weed dynamics due to different cabbage based intercropping systems

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Abstract
A study was undertaken to assess the efficacy of intercropping system in reducing weed infestation in cabbage intercropping with vegetables namely methi, Palak, radish, beetroot and cluster bean in randomized complete block design with 4 replications. The results revealed that the number of weeds was significantly reduced in intercropping as compared to sole crop and the least weed count was observed in cabbage intercropped with methi (10.00) and radish (11.00). Weed dry weight was also reduced in intercropped cabbage with the least weed dry weight reported in cabbage with methi (9.50 g). Weed smothering efficiency also followed the same trend with cabbage intercropped with methi (59.93%) giving the best performance with regard to this attribute. The results of this study showed that cabbage intercropped with methi and radish could successfully reduce weed infestation as compared to sole crop of cabbage.

Keywords: Weed dynamics, cabbage, intercropping, systems

Introduction
Cabbage is one of the most important members of the Brassica family. It is widely cultivated throughout the country and with the development of improved varieties and hybrids its area under cultivation has increased substantially in India. Like other pests, weeds have become a major problem in crop production particularly when their population and density becomes a hindrance to crop performance. Weed reduction is considered one of the most important advantages that intercropping can offer. The use of intercrop to smother weeds has been shown to be successful (Rao and Shetty, 1976) [10]. Weeds are suppressed if intercrops are more effective in nutrient uptake to weeds. Alleopathic interactions can also occur between weeds, between weeds and crops, or between crops. Alleopathy is different from other interspecies competition in that the detrimental effect is not through direct competition for nutrients or space but is exerted through release of a chemical by one component (Gebru, 2015) [4]. Orluchukwu *et al*. (2013) [8] noted reduced weed infestation in okra, maize and pepper intercrop and revealed that weed biomass were significantly lower in all forms of intercropping patterns compared to sole cropping. Weed smothering efficiency was highest in mixed pattern of intercropping at 45.7%. Weed management through intercropping has been found to be particularly useful for small scale farmers whose cropping pattern limits the use of herbicides and who prefer traditional means of weed management, hand weeding and hoeing. Moreover, studies on integrated weed management systems have suggested intercropping as an option for weed management. Therefore, intercropping can be seen as one option for reducing weed problems through non-chemical methods (Vandermeer, 1989) [13]. To study the effect of intercropping on weed dynamics in cabbage, this experiment was undertaken with an aim to assess the ability of intercropping in cabbage to reduce weeds.

Material and Methods
The experiment was conducted in sandy loam soil with pH 7.0 at the Main Horticultural Research and Extension Centre (MHREC), University of Horticulture Sciences, Bagalkot (Karnataka), College of Horticulture, Bagalkot which is located in the Northern part of the state with 16.1635° N latitude and 75.6172° E at 563 meters above mean sea level. The field was laid out in RCBD design with four replications.

The crops methi, palak, radish, beetroot and cluster bean were used as component crops in the intercropping pattern. Cabbage was planted at a spacing of 45 X 30 cm and the component crops of methi and palak were adjusted to be planted in two rows each in between the rows of cabbage. Respective sole crops of the component crops were also raised at recommended spacing. Cabbage seedlings were raised and transplanted into the field followed by direct seeding of the component crops afterwards.

Weed count and smothering efficiency

The weed count per m^2 was adjudged at 30 days after planting. A quadrat measuring 1 × 1 m in each individual plot was taken and the number of monocot and dicot weed species was counted. The weeds were then oven - dried at 65-70°C for 48 hours for biomass determination.

The Weed smothering efficiency of the various intercropping patterns was determined based on weed control efficiency according to Subramanian *et al.* (1991) [11] as follows:

$$\text{Weed smothering efficiency (\%)} = \frac{\text{WDWT (monocrop)} - \text{WDWT (intercrop)}}{\text{WDWT (monocrop)}}$$

Where,

WDWT = Weed dry weight

Data analysis

Data from the trials were subjected to analysis of variance (ANOVA) and differences between means were separated using least significant difference (LSD) at 5% level of significance.

Results

Weed count /m^2

The mean number of monocot weeds at 30 DAT was 6.94 weeds per m^2. Among the cabbage based treatments, the monocot weed count was maximum (6.70 weeds per m^2) in cabbage intercropped with cluster bean and the minimum (3.33 weeds per m^2) weed count was observed in cabbage intercropped with methi followed by cabbage with beetroot (4.00 weeds per m^2).

With respect to the number of dicot weeds per m^2 at 30 DAT, among cabbage based treatments the maximum dicot weed count was reported in sole cropped cabbage at 17.70 dicot weeds per m^2. The intercropping treatments gave reduced weed count for cabbage with radish and cabbage with methi at 6.30 and 6.70 dicot weeds per m^2 respectively. The overall mean number of dicot weeds observed was 19.48 weeds per m^2.

The mean number of total weeds at 30 DAT was 26.45 weeds per m^2. Among the cabbage based treatments, the highest number of weeds was observed in cabbage as sole crop with 23.00 weeds per m^2. The intercrop treatments brought better weed control than sole cropping with the minimum weed count per m^2 observed in cabbage intercropped with methi at 10.00 number of weeds per m^2 followed by cabbage intercropped with radish recording 11.00 weeds per m^2.

Weed dry weight and Weed smothering efficiency

The data on weed dry matter is presented in the table 2. The weed dry weight in the intercrop treatments was minimum in cabbage + methi with 9.50 g dry weight and maximum in sole crop of cabbage at 24.35 g. Subsequently, the data on weed smothering efficiency is presented in table 6. The weed smothering efficiency of cabbage intercropped with methi (59.93%) was maximum followed by cabbage with radish (59.13%). The lowest weed smothering efficiency was observed in cabbage intercropped with cluster bean at 3.00%.

Discussion

The experimental findings on weed parameters showed that intercropping reduced the weed count per m^2 where the total weed count and the weed biomass were found to be reduced in all the intercropping systems compared to sole crops. This result is in accordance with the findings of McGill-Christ and Trenbath (1984) [7] who reported that sole cropping showed increased weed occurrence due to sparse canopy. Moreover, earlier reports by Ofosu-Anim and Limbani (2007), Franco *et al.* (2018) and Eskandari and Ghanbari (2010) [3, 2] suggest the reduction of weed count and weed biomass in intercropping. Liebman and Dyck (1993) [6] opined that weed population density and biomass production are significantly reduced by spatial diversification caused by intercropping. Weeds are controlled in intercropping due to increased ground cover, shade, efficient utilization of resources, allelopathic effects between the crops and the weeds etc. The negative results of weed parameters in cluster bean might be due to its erect growing habit coupled by its sparse foliage and drought hardiness which when coupled with cabbage might have resulted in weeds receiving more sunlight and excess available moisture leading to increased weed count and biomass. Weed smothering efficiency also followed the same trajectory with intercropping in general being more successful in smothering weeds than mono cropping. The reduced photosynthetic active radiation (PAR) and increased interference from the component crops along with increased ground cover may have resulted in relatively low incidence of weeds irrespective of planting patterns (Orluchukwu and Udensi., 2013) [8]. This is in confirmation with studies by Geetha *et al.* (2019), Omovbude *et al.* (2017), Shah *et al.* (2011) and Amosun and Aduramigba-Modupe (2016) [5, 9, 12, 1] who reported that the weed smothering efficiency (WSE) was significantly higher in intercropping over mono cropping.

Table 1: Effect of intercropping system on weed count per m^2 at 30 DAT

Sl. No	Treatment	Monocot (no/m^2)	Dicot (no/m^2)	Total (no/m^2)
1	Cabbage + Methi (T_1)	3.33	6.70	10.00
2	Cabbage + Palak (T_2)	5.33	13.00	18.70
3	Cabbage + Radish (T_3)	4.70	6.30	11.00
4	Cabbage + Beetroot (T_4)	4.00	11.30	15.33
5	Cabbage + Cluster bean (T_5)	6.70	14.60	21.33
6	Cabbage (Sole crop) (T_6)	5.33	17.70	23.00
7	Methi (T_7)	8.33	30.70	39.00
8	Palak (T_8)	10.70	28.00	38.70
9	Radish (T_9)	11.33	14.70	26.00
10	Beetroot (T_{10})	10.33	41.00	51.33

11	Cluster bean (T_{11})	3.33	30.33	36.7
	Mean	6.94	19.48	26.45
	SE m ±	0.86	2.70	2.39
	CV @ 5%	24.71	27.67	18.07
	CD %	2.48	7.79	6.90

Table 2: Weed smothering efficiency in different intercropping combinations

Sl. No.	Intercrop combination	Weed smothering efficiency (WSE) %
1	Cabbage + Methi (T_1)	59.93
2	Cabbage + Palak (T_2)	13.75
3	Cabbage + Radish (T_3)	59.13
4	Cabbage + Beetroot (T_4)	3.28
5	Cabbage + Cluster bean (T_5)	3.0

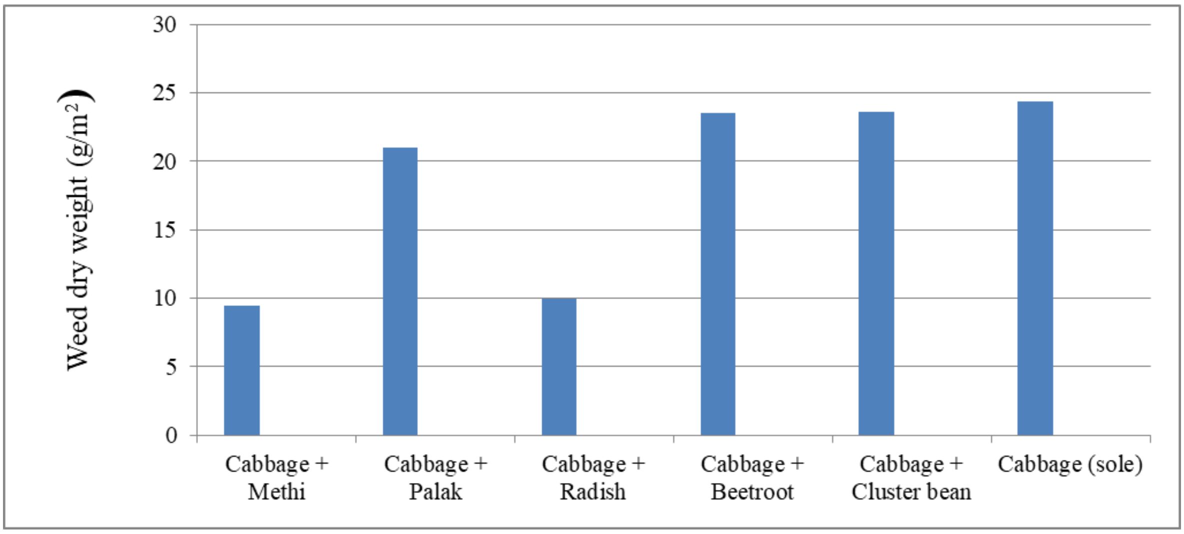

Fig 1: Weed dry weight recorded at 30 DAT under different intercropping treatments of cabbage

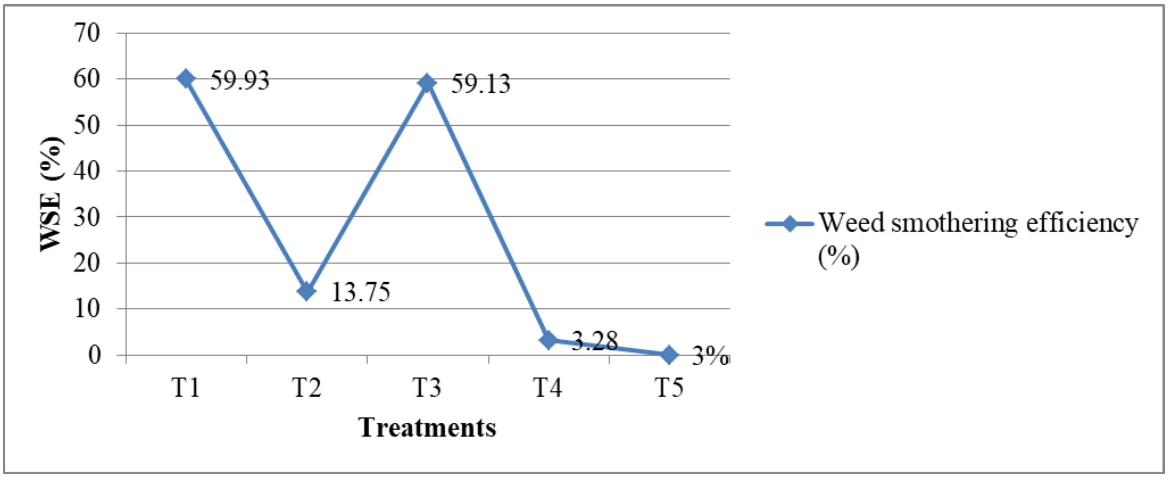

Fig 2: Weed smothering efficiency (%)

Conclusion

The study indicates that weed control in cabbage can be improved by intercropping with methi, palak, radish, beetroot and cluster bean with cabbage and methi intercropping in particular showing benefits in reduction in weed count, reduced weed biomass and increased weed suppression efficiency. Therefore, the correct choice of crops is absolutely necessary to insure efficient utilization of resources thereby devoid the weeds of their congenial growing conditions. In order to harness maximum benefits of weed control benefits through intercropping, proper considerations to spacing, planting patterns, growing habits, root depths and management practices are of utmost importance.

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