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Effect of crop density and weed management practices in *rabi* sweet corn on quality of sweet corn kernels and its residual effect on seed quality of succeeding greengram in sweet corn-greengram cropping systems in Alfisols under tropical wet and dry climate condition

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Abstract
A field experiment was conducted under tropical wet and dry climate condition at Bhubaneswar, Odisha, India during *Rabi* and *zaid* of 2021-22 and 2022-23. The research was laid out in a split plot design comprising of three numbers of main plot and six numbers of sub-plot treatments which were replicated thrice. The main plot treatments consisted of crop geometry *viz*., 40 cm x 20 cm (P1), 50 cm x 20 cm (P2) and 60 cm x 20 cm (P3) while, the sub-plot treatments consisted of weed management practices *viz*., live mulch with cowpea up to flowering initiation at 30 DAS (W1), live mulch with cowpea up to 1st plucking at 45 DAS (W2), application of pendimethalin @ 0.75 kg a.i./ha as pre-emergence (W3), farmers' practice (Hoeing and earthing up at 20 DAS) (W4), weed free check (W5) and weedy check (W6). Weed management practices affected the protein content of sweet corn kernels significantly wherein weed free check recorded significantly higher protein content of kernels followed by application of pendimethalin (W3) and live mulch with cowpea up to 45 DAS (W2). Weedy check (W6) recorded the lowest values in both the experimental years. Crop geometry had non-significant effect on protein content of kernels of sweet corn and seeds of greengram. In succeeding crop of greengram, significantly lower seed protein content of greengram was registered under weedy check (W6) while rest of the treatments remained statistically similar. The studies proved the detrimental effect of weeds on protein content of sweet corn and greengram in the cropping system.

Keywords: Sweet corn, greengram, weed management, crop geometry, live mulch, Pendimethalin

Introduction
With the surging pressure on agriculture sector under shrinking agricultural lands, huge population pressure and increasing threat to human health owing to pesticide loads in cropping systems, it is essential to study the impact of agricultural practices on nutritional quality of crops. Globally, at present the progress on reduction of cases of anaemia in women aged 15-49 years is apparently inadequate to achieve the World Health Assembly global nutrition target of halving anaemia prevalence by 2030. Besides this, the prevalence of anaemia in children also scales high as evident from an extensive study from 2000 to 2019 as published in "The Lancet Global Health" by Stevens *et al*., 2022. It is estimated that in the next 10-15 years, corn would become the most widely traded crop of the world under threatening climate change conditions and uncertainty in extreme weather conditions (Erenstein *et al*., 2022) [5].
As weeds are known to cause the maximum losses in crops as pests, farmers find reliance on herbicides easier to control various categories of weeds. This has resulted in increase in pesticide load of agricultural lands (Rani *et al*., 2020) [9]. Under the changing climatic events, farmers are advised to adopt low duty crops in tropical wet and dry climate condition. So, cash crop like sweet corn (*Zea mays* var. saccharata) and short duration crop like greengram are gaining popularity amongst Indian farmers. The herbicide load on sweet corn is on an

increasing trend. A famous finding on women exposed to atrazine herbicide during gestation and lactation periods proved that expression of regulatory orphan nuclear hormone are affected which lead to a rise in susceptibility to Parkinson's disease (Sun *et al*., 2014) [12]. Thus, it is vital to strengthen understanding on the effect of various weed management and agronomic practices aimed at influencing weed dynamics and their by its impact on nutritional quality of sweet corn and its residual effect on nutritional quality of greengram under sweet corn-greengram system under under tropical wet and dry climate condition.

Materials and Methods

A field experiment was undertaken at the Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India, consecutively during the 2021-22 and 2022-23. The soil of the experimental site was classified as Alfisol order and was low in organic matter and nitrogen, medium in phosphorus and potassium and had a sandy loam texture. Congenial weather parameters prevailed for the crops during the study period. The experiment was laid in split-plot design with three replications. The crop geometry as main plot consisted of three treatments namely, P1: 40 cm x 20 cm, P2: 50 cm x 20 cm and P3: 60 cm x 20 cm. While there were six weed management treatments as subplots namely, W1: Live mulch with cowpea up to 30 DAS, W2: Live mulch with cowpea up to 45 DAS, W3: Application of pendimethalin @ 0.75 kg a.i./ ha, W4: Farmers' practice (Hoeing and earthing up at 20 DAS), W5: Weed free check and W6: Weedy check. These treatments were imposed on sweet corn and after harvest of the crop, greengram was immediately sown as a summer crop to study the residual effect of the treatments imposed on sweet corn. After harvest of sweet corn, the cobs were randomly sampled from each of the plots, shelled and kernels were removed. Samples of kernels for each of the treatments were collected separately. The samples were oven dried at 70 °C for 24-72 hours depending on the initial moisture content following which they were ground, passed through a 2 mm sieve and were analyzed for the estimation of nitrogen by following the standard method given by Jackson, 1973 by digestion with concentrated H_2SO_4 in presence of digestion mixture ($CuSO_2$ + K_2SO_4 + Selenium powder in 200:10:1) followed by digestion in Microkjeldahl - apparatus and ammonia gas liberated was trapped in boric acid containing mixed indicator. Later, it was titrated against standard H_2SO_4 and the amount of ammonia liberated was estimated which indicated the nitrogen content as per standard procedure. The nitrogen content determined for the kernels of sweet corn and greengram seeds was used to estimate protein content of seeds by multiplying with a factor of 6.25 to obtain the protein content in percent (%).

Protein content (%) = Nitrogen content (%) x 6.25

The same procedure was followed for estimation of protein content of seeds of greengram after harvest of succeeding summer greengram to evaluate the residual effect of crop geometry and weed management treatments imposed on preceding sweet corn on protein content of seeds of succeeding summer greengram.

The data recorded after laboratory analysis of protein content were subjected to statistical analysis as per the standard procedure given by Gomez and Gomez, 1984 for split plot design.

Result

After consecutive two years of research during 2021-22 and 2022-23, it was found that the protein content of sweet corn kernels was significantly affected by different weed management tactics (Table 1). However, various planting densities slightly affected the kernel protein content which was statistically non-significant. In evaluation of weed management practices, weed free check (W5) registered significantly highest amount of protein content closely followed by application of pendimethalin @ 0.75 kg a.i./ha (W3), live mulch with cowpea up to 45 DAS (W2) and live mulch with cowpea up to 30 DAS (W1) which remained statistically similar. Weedy check (W6) recorded significantly lowest values which was statistically similar to farmers' practice (W4) during both the years of research. The interaction effect among the crop geometry and weed management practices was non-significant.

In succeeding crop of greengram, statistical analyses established that the residual effect of crop geometry in preceding sweet corn on the greengram seed protein content was non-significant, while weed management practices significantly affected the protein content of seeds of greengram (Table 2). Amongst residual effect of weed management practices, significantly lowest seed protein content of greengram was registered under weedy check (W6) while rest of the treatments remained at par with each other. The interaction effect among treatments was found to be statistically non-significant.

Table 1: Effect of crop geometry and weed management practices on protein content of kernels of *rabi* sweet corn

Treatment	Protein content (g per 100 g dry weight)		
	2021-22	**2022-23**	**Pooled**
Crop geometry			
P1	8.41	8.43	8.42
P2	8.54	8.51	8.53
P3	8.72	8.76	8.74
Sem (=/-)	0.36	0.21	0.17
CD (0.05)	NS	NS	NS
Weed management			
W1	8.92	8.95	8.93
W2	9.07	9.09	9.08
W3	9.11	9.17	9.14
W4	8.15	8.21	8.18
W5	9.32	9.48	9.40
W6	6.77	6.49	6.63
Treatment mean	8.56	8.57	8.56
Sem (=/-)	0.14	0.22	0.19
CD (0.05)	0.41	0.68	0.59
Interaction effect at 5%	NS	NS	NS

Table 2: Residual effect of crop geometry and weed management practices in *rabi* sweet corn seed protein content (%) at harvest of succeeding greengram

Treatment	Protein content (g per 100 g dry weight)		
	2021-22	**2022-23**	**Pooled**
Crop geometry			
P1	21.2	21.1	21.17
P2	22.0	21.8	21.90
P3	21.9	21.7	21.79
Sem (=/-)	6.30	5.94	6.30
CD (0.05)	NS	NS	NS
Weed management			
W1	22.1	21.3	21.72
W2	23.4	22.9	23.13
W3	22.2	22.4	22.29
W4	21.8	22.3	22.05
W5	22.2	22.2	22.18
W6	18.4	18.3	18.34
Treatment mean	21.68	21.55	21.62
Sem (=/-)	1.10	1.02	1.09
CD (0.05)	3.37	3.18	3.37
Interaction effect at 5%	NS	NS	NS

Discussion

The findings of this two-year study (2021-22 and 2022-23) provide valuable insights into the impact of weed management practices and planting densities on the protein content of sweet corn kernels and the residual effects on the succeeding crop of greengram. The significant influence of weed management tactics on sweet corn kernel protein content underscores the importance of effective weed control in optimizing crop quality.

The findings of this two-year study (2021-22 and 2022-23) provide valuable insights into the impact of weed management practices and planting densities on the protein content of sweet corn kernels and the residual effects on the succeeding crop of greengram. The significant influence of weed management tactics on sweet corn kernel protein content underscores the importance of effective weed control in optimizing crop quality.

The protein content of sweet corn kernels were not significantly affected by the plant geometry treatments (Deewan *et al*., 2017) [4] while, weed management practices posed a significant effect. The highest values were recorded by weed free check (W5) followed by pendimethalin @ 0.75 kg a.i./ha (W3), live mulch with cowpea up to 45 DAS (W2), live mulch with cowpea up to 30 DAS (W1) and farmers' practice (W4) which were at par while, weedy check (W6) recorded significantly lowest values during both the years of experimentation (Burcu and Akgün, 2018 and Tarde, 2022) [2, 14]. This might be due to the reason that quality parameters of sweet corn kernels are mostly affected by genetic makeup of the hybrid, crop management practices and environmental factors. Crop geometry could not significantly affect the quality parameters which could be due to the reason that kernel composition is regulated by transcriptomic and metabolic networks which are mostly governed by genetic factors and extreme crop management changes (Tarde, 2020; Deewan *et al*., 2017 and Rosa, 2015) [13, 4, 10].

In succeeding greengram crop, there was non-significant residual effect seen at all the crop growth stages due to planting patterns of preceding sweet corn crop due to similar reasons. Moreover, this could be due to no significant influence of plant geometry in altering the soil physical and chemical properties as established by Masih *et al*., 2018 [8]; Alahmad *et al*., 2024 [1] and Das *et al*., 2018 [3].

On the other hand, weed management practices could significantly affect the quality parameters which could be due to the severe crop-weed competition in weedy check (W6) leading to severe competition for nutrients, space and other resources as compared to rest of the treatments. This could lead to paramount stress on the crop for uptake of essential soil elements resulting in reduced photosynthesis of crop and partitioning of photosynthates from source to sink which resulted in comparatively poor quality of kernels in weedy check (W6) as compared to rest of the treatments.

In succeeding greengram, there was significant residual effect of weed management practices on seed protein content of greengram. Weedy check (W6) recorded significantly lowest seed protein content while rest of the treatments remained at par with each other which could be ascribed to severe weed infestations in weedy check that could have led to build up of seed bank in the soil owing to weed flushes and seed sets that might have led to their infestation in succeeding crop and higher crop-weed competition. This might have reduced the nitrogen uptake by crop and hence, conversion of N to protein resulting in lower protein content. This is in conformity to the findings of Burcu and Akgün, 2018 [2]; Deewan *et al*., 2017 [4]; Tarde, 2020 [13] and Tarde, 2022 [14].

Conclusion

In conclusion, findings of the research suggest that weed-free conditions and live mulch with cowpea can improve protein content in sweet corn kernels and can also benefit the protein content of seeds of succeeding crop of greengram as the residual effects of these practices.

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