The Pharma Innovation Journal 2022; SP-11(1): 764-766

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(1): 764-766

www.thepharmajournal.com
Received: 07-11-2021
Accepted: 09-12-2021

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Impact of wool waste, FYM and fertilizer on cabbage

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Abstract
An investigation was carried out in an Aridisol during rabi season 2015-16 at Agriculture Research Station, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan) to find out the impact of wool waste along with Fam yard manure (FYM) and chemical fertilizer on growth, yield attributes and yield of cabbage. Application of wool waste @ 7.5 t ha^{-1} along with FYM @ 7.5 t ha^{-1} (W_1) and application of highest dose of chemical fertilizer (F_3) gave maximum growth, yield attributes and yield of cabbage. Perimeter of cabbage head (25.06 per cent), head weight (39.64 per cent), head yield (44.80 per cent) and stover yield (36.62 per cent) increased by treatment W_1 over control. Similarly, these parameters were increased 36.62, 27.38 and 45.11 percent by the application of 125% recommended dose of chemical fertilizer over control. The combined effect of wool waste @ 7.5 t ha^{-1} in conjunction with FYM @ 7.5 t ha^{-1} and 125% recommended dose of chemical fertilizer (W_1F_3) gave maximum head weight (335.77 q ha^{-1}) which was at par with wool waste @ 7.5 t ha^{-1} in conjunction with FYM @ 7.5 t ha^{-1} and 100% recommended dose of chemical fertilizer (W_1F_2).

Keywords: FYM, wool waste, growth, yield, cabbage

Introduction
Cabbage (*Brassica oleracea var. capitata* L.) is belong to family Crucifereae (*Brassicaceae*). It is the popular vegetable all around the world in respect of area, production and availability (Smith, 1995) [12]. Cabbage is an important leafy vegetable in our country and rich in many minerals, vitamins as well as small amount of protein. It neutralizes acidity and improves digestion and appetite (Katyal and Chadha, 1985) [9]. It is grown in almost all states of India including Orissa, Punjab, Rajasthan, West Bengal, Uttar Pradesh, Bihar, Karnataka, Maharashtra, Gujarat, Punjab and Himachal Pradesh (Fageria *et al*., 2003; Rashid, 2020) [6, 11]
One of the main qualities of wool is biodegradable, which means that when buried into soil, the keratin biopolymer is degraded by microorganisms and releases nutrients essential to the crops. Wool in non-woven form can be used as weed mats, which initially supress weed growth and slowly break down to release nutrients for the crops (Hempe, 2014) [8]. Low grade raw wool or wool waste can be used as an amendment. Wool waste, FYM and chemical fertilizer could be an important option to get maintain yield because wool waste slowly decomposes in soil and it can slowly release nutrients during entire period of crop growth. Hence, it can be used as slow-release fertilizer (Zheljazkov, 2010) [14]. It also interestingly notes that wool 'seems to have greater imbibition's for water since soil moisture content at harvest was greater in soils than without wool amendment (Abdallah *et al*., 2019) [3].
Negligible use of organic manures and non-availability of good quality of manure in time put pressure to find out alternate organic resources for crop production. Therefore, the present investigation was carried out to find out the best suitable options of wool waste in combination with FYM and chemical fertilizer.

Materials and Methods
An experiment was conducted during Rabi season of 2015-16 at the Agriculture Research Station, SKRAU, Bikaner, Rajasthan (28° 01' N, 73° 22' E and 234.7 m above sea level). The soil of the experimental field was sandy in texture, low in organic carbon (0.16%), nitrogen (89.24 kg ha^{-1}), phosphorus (27.64 kg ha^{-1}), iron (6.60 ppm) and zinc (0.97 ppm), and medium in potash (224.29 kg ha^{-1}). Wool waste and FYM were applied in each plot as per treatments combination before one month of transplanting of cabbage seedlings. The dose of nitrogen, phosphorus, potassium and sulphur were applied through urea, diammonium phosphate, murate of potash and elemental sulphur respectively, as per the treatment combination. Half dose of N, full dose of P and K were applied as basal at the time of transplanting of cabbage

seedlings. The remaining N was applied after 30 days of transplanting. Sulphur was applied as per treatment combination @ 40 kg ha^{-1} through elemental sulphur before 10 days of transplanting. All the growth and yield attributes character were observed and analysed with the standard statistical method.

Results and Discussion

Perimeter of head

The data on perimeter of cabbage head depleted in figure 1 showed that application of organic materials and fertilizer levels significantly enhanced the perimeter of cabbage head. The maximum perimeter of cabbage head (52.04 cm) was recorded with treatment W_1 i.e. 7.5 t ha^{-1} each wool waste and FYM (1:1). Significant increase in perimeter of cabbage head was also recorded with increasing dose of fertilizer over control. Maximum perimeter value was recorded as 50.76 cm with F_3 i.e. 125 per cent recommended dose of fertilizer. While F_2 i.e. 100 per cent recommended dose of fertilizer were found at par with F_3.

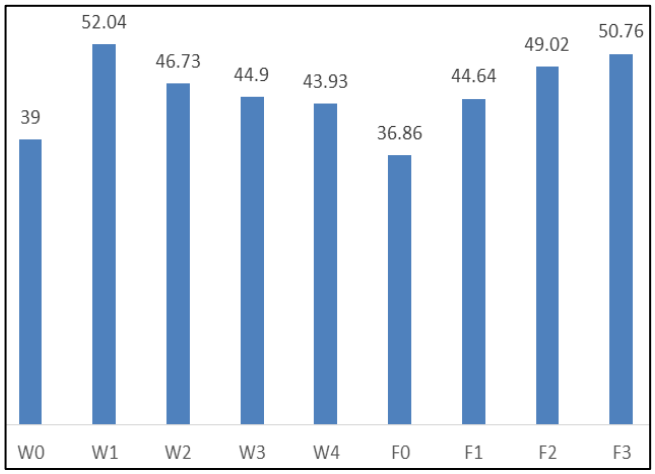

Fig 1: Impact of wool waste with FYM and fertilizer on perimeter of cabbage head (in cm).

Head weight

Data pertaining to head weight depicted in figure 2 clearly showed positive effect of different organic materials on head weight. The maximum head weight recorded in W_1 (9.46 kg) which was significantly higher over control (5.71 kg). Application of 125 per cent recommended dose of fertilizer gave maximum head weight (10.33 kg) which was significantly higher to control and F_1 treatment. The per cent of increase was 45.11 over control.

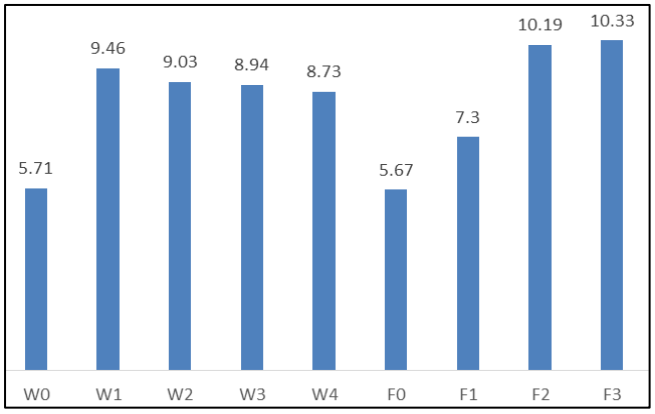

Fig 2: Impact of wool waste with FYM and fertilizer on head weight (in kg).

Head and Stover yield of cabbage

The data on head yield and stover yield of cabbage presented in figure 3. The maximum head yield (280.44 q ha^{-1}) was recorded with the treatment W_1 followed by W_2, W_3 and W_4. The minimum head yield was recorded in control treatment (154.80 q ha^{-1}). Similarly, increasing application of chemical fertilizer gave significant head yield over control.

The maximum head yield was recorded with the application of 125% recommended dose of fertilizer which was 38.15 per cent higher over control. Similar trend was also observed in stover yield of cabbage. Treatment W_1, W_2, W_3 and W_4 with value of 131.13 q ha^{-1}, 125.80 q ha^{-1}, 116.61 q ha^{-1} and 100.40 q ha^{-1} significantly superior over control W_0 (83.11 q ha^{-1}). These findings are corroborating with the findings of Das *et al*., (2015) [5], Nagar *et al*., (2017) [10] and Baghel *et al*., (2017) [4].

Likewise, increase in stover yield of cabbage was observed with every increase dose of RDF. The maximum yield was observed with 125% recommended dose of fertilizer F_3 (126.16 q ha^{-1}) which was 27.85 per cent high over control. Order of organic materials in influencing the head yield and stover yield of cabbage was as follows $W_1>W_2>W_3>W_4>W_0$. Zheljazkov (2010) [14] also reported that wool waste increases the plant yields and essential oil content of Swiss chard and basil. The similar trend was also observed by many researchers. Aktar *et al*. (1996) [1]; Azad (2000) [2]; Haque (2000) [7] and Souza *et al*. (2008) [13] also supported the result of present findings.

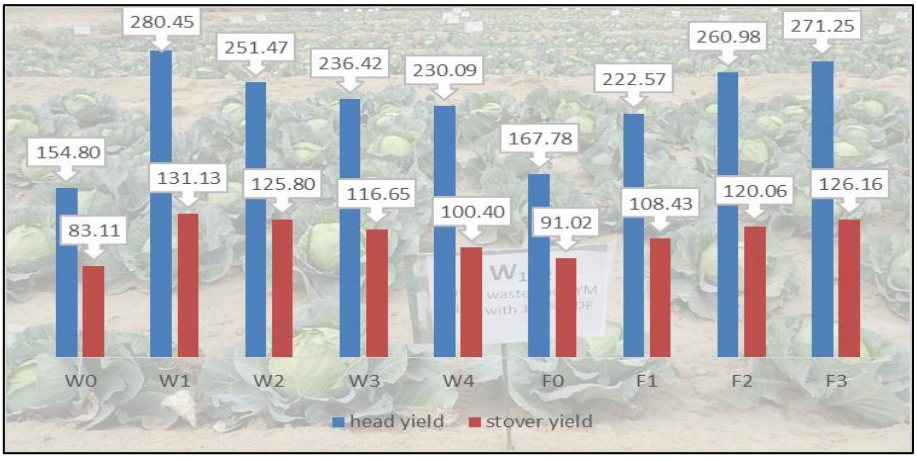

Fig 3: Impact of wool waste with FYM on head and stover yield of cabbage (q ha^{-1}).

Interaction

Combined application of organic materials and fertilizers significantly enhanced the head yield. Maximum head yield was recorded 335.77 q ha^{-1} with the application of wool waste @ 7.5 t ha^{-1} + FYM @ 7.5 t ha^{-1} along with 125 per cent recommended dose of fertilizer (W_1F_3), followed by 331.81 q ha^{-1} with treatment W_1F_2 and 291.46 q ha^{-1} with W_2F_3 (table 1). The per cent increase of head yield was 65.75 per cent over control.

Table 1: Combined effect of wool waste in conjunction with FYM and chemical fertilizer on head yield of cabbage (q ha^{-1}).

W x F	Organic materials (t ha^{-1})				
	W_0	W_1	W_2	W_3	W_4
Fertilizer Levels (kg ha^{-1})					
F_0	115.00	191.79	177.99	177.96	176.15
F_1	143.12	262.43	252.59	232.57	222.16
F_2	168.82	331.81	283.85	264.43	256.01
F_3	192.27	335.77	291.46	270.73	266.03
CD-I at 5%	14.85				
CD-II at 5%	11.87				

Conclusion

On the basis of results of present investigation, it can be concluded that combined application of wool waste and FYM @ 7.5 t ha^{-1} along with 125 per cent RDF gave maximum yield of cabbage.

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