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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 525-527

www.thepharmajournal.com
Received: 02-02-2022
Accepted: 09-03-2022

Owais Ali Wani
Division of Soil Sciences and Agricultural Chemistry FOA SKUAST K, Jammu and Kashmir, India

Farida Akhter
Division of Soil Sciences and Agricultural Chemistry FOA SKUAST K, Jammu and Kashmir, India

Shakeel A Mir
Division of Soil Sciences and Agricultural Chemistry FOA SKUAST K, Jammu and Kashmir, India

Raihana H Kanth
Faculty of Agriculture SKAUST K, Jammu and Kashmir, India

Zahoor A Baba
Davison of Basic Sciences FOA SKAUST K, Jammu and Kashmir, India

FA Pir
Division of Agronomy FOA SKAUST K, Jammu and Kashmir, India

Sameer Ahmad Dar
DOON Valley College of Education, Dehradun, Uttarakhand, India

Anurag Kumar
Doon (pg) College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Arpita Dey
Doon (pg) College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Nazir Hussain
Division of Agronomy FOA SKAUST K, Jammu and Kashmir, India

Yasir Ayoub
Doon (pg) College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Corresponding Author:
Owais Ali Wani
Division of Soil Sciences and Agricultural Chemistry FOA SKUAST K, Jammu and Kashmir, India

Influence of organic amendments rate of application and fertilizer regimes on growth of maize under temperate conditions

Owais Ali Wani, Farida Akhter, Shakeel A Mir, Raihana H Kanth, Zahoor A Baba, FA Pir, Sameer Ahmad Dar, Anurag Kumar, Arpita Dey, Nazir Hussain and Yasir Ayoub

Abstract
Maize is major crop grown in temperate ecologies hence improved nutrient management strategies are imperative. Firstly type of amendment and rate exhibited clear difference in Plant Height. Lowest Plant Height was recorded in A7 75.91 and highest in A2 (Apple 400 ℃) 129.79. Trend in Plant Height among amendments was as follows A3 > A2 >A6 >A5 >A7 >A1 >A4 with mean values 154.23, 248.95, 259.45, 146.23, 217.67, 233.34, 162.06. Amendments and rate has visible impact of maize plant parameters. These advanced residue management strategies should be adopted in temperate Himalayas.

Keywords: Organic, fertilizer, regimes, maize, conditions

Introduction
Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Maize, also known as corn, is a cereal grain that was first grown by people in Central America. It is now the third most important cereal crop in the world and is called the 'Queen of Cereals'(Jan *et al.*, 2020; Mansoor *et al.*, 2021) [4, 10]. It is cultivated on nearly 190 m ha in about 165 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 39% in the global grain production. Maize is the major crop of Jammu and Kashmir in terms of acreage under any crop. Maize is gown in the state during kharif season and about 85% of the cropped area is rainfed (Gull *et al.*, 2020; Rahman *et al.*, 2021) [2, 13]. The maize crop as such is prone to the vagaries of rainfall distribution. Maize is grown under wide range of climatic conditions, mostly in warmer parts of the temperate region and areas of humid sub-tropical climate. Maize is widely cultivated in Jammu and Kashmir, being grown in the Kandi, Karewa, and plain areas. Maize can grow well on a variety of soils but it performs better on well- drained fertile loams and silty loams. Maize is grown in almost all the districts of the state except Leh and Kargil (Nisa *et al.*; Kumar *et al.*, 2022; Zahed *et al.*, 2022) [11, 15]. Its cultivation is largely confined to the Kandi areas and hilly tracts. The main concentration of maize is found in the Doda district in which it occupies about 82 per cent of the total cropped area. Rajauri, Poonch and Udhampur are the other districts in which its concentration is significantly high. It needs about 30 °C temperature at the time of germination, growth and development, and over 20 °C at the time of ripening. In terms of hectare, maize was the first ranking crop in Jammu and Kashmir in 1994-95. Nearly one-third of the total cropped area was devoted to its cultivation. It is the staple food of Gujjars and Bakarwals, living in the Kandi and hilly areas. Moreover, the grains form an important cattle food, being fed to farm cattle and horses. Biochar is produced from the pyrolysis of biomass under low oxygen conditions (Bashir *et al.*, 2021; Mansoor *et al.*, 2022; Zahed *et al.*, 2022) [1, 9, 15]. Biochar is a carbonaceous, recalcitrant material and has been used for several thousand years. It is called charcoal, when the feedstock is woody biomass. It is heated under conditions of limited or no air (Joseph *et al.*, 2009) [5]. Biochar is not only rich in carbon but also plant nutrients (Ippolito *et al.*, 2012) [3], which are used to supply nutrient deficient plants and to reclaim degraded soil (Novak *et al.*, 2009) [12].

Material and Method

Feedstock will be pyrolysed at two different temperatures i.e., 400 ℃ and 600 ℃ separately for 3 hours at 8 ℃ per minute gradual increase. After completion of process pyrolysed feedstock will be let to be cooled then sieved through 1 mm mesh. Plant height of five tagged plants in penultimate rows of each plot. The plant height was taken from the base of soil surface to fully opened top leaf. Plant samples were dried in hot air oven and then weight was taken.

Results and Discussion

Plant height in all three factors employed while conducting experiment was assessed. Firstly type of amendment and rate exhibited clear difference in Plant Height. Lowest Plant Height was recorded in A7 75.91 and highest in A2 (Apple 400℃) 129.79. Trend in Plant Height among amendments was as follows A3 > A2 >A6 >A5 >A7 >A1 >A4 with mean values 154.23, 248.95, 259.45, 146.23, 217.67, 233.34, 162.06. Between the amendments A1 and A7 where statistically same while others differed significantly as clearly indicated in (Table 1, Figure 1) with standard errors. In second year also trend was similar but significant change with respect to year was noticed. Consequent factor that is rate had exhibited clear trend with highest increase in M (medium rate) 215.93 and differed with others rates significantly with others. Trend of Plant Height in case of rate of application is M > H >L with mean values 212.72, 215.93, 180.74. In case of fertilisation and without fertilisation F > N with mean values 188.13, 218.13. In all three factors dry weight was assessed. Firstly type of amendment and rate exhibited clear difference in Dry Weight. Lowest Dry Weight was recorded in A7 96.39 and highest in A3 (Apple 600℃) 157.44. Trend in Dry Weight among amendments was as follows A3 > A2 >A6 >A5 >A7 >A1 >A4 with mean values 91.92, 145.91, 151.9, 87.36, 128.08, 137.01, 96.39. Between the amendments A1, A4 and A7 where statistically same while others differed significantly as clearly indicated in (Table 1, Figure 1) with standard errors. In second year also trend was similar but significant change with respect to year was noticed. Consequent factor that is rate had exhibited clear trend with highest increase in M (medium rate) 127.09 and differed with others rates significantly with others. Trend of Dry Weight in case of rate of application is M >H >L with mean values 125.26, 127.09, 107.04. In case of fertilisation and without fertilisation F > N with mean values 111.25, 128.35.

The positive influence of residue-derived organic matter on soil physical, chemical, and biological properties improves crop production (Lal, 2006). Well-aggregated soils are highly productive because they allow a proper placement of seeds, seedling emergence, and uptake of water and nutrients. Crop residues are a major source of essential nutrients. Thus, residue removal reduces available N, P, and K and other essential nutrients important to crop production. Specifically, SOC concentration influences crop production by (i) increasing the availability and absorption of water and essential nutrients (e.g., N, P, S), (ii) improving root development and seedling emergence, and (iii) moderating soil temperature and moisture regimes (Weil and Magdoff, 2004; Mahdi *et al.*, 2021; Kumar *et al.*, 2022).

Table 1: Plant height and dry matter as influenced by various factors

				Factors
Amendment	**PH Ist Year**	**PH 2nd Year**	**Dry Weight Ist Year**	**Dry Weight 2nd Year**
A1	154.23 ± 2.91d	159.95 ± 2.96c	91.92 ± 1.66d	95.18 ± 1.69c
A2	248.95 ± 7.1ab	258.5 ± 7.13a	145.91 ± 4.05ab	151.36 ± 4.06a
A3	259.45 ± 7.54a	269.17 ± 7.55a	151.9 ± 4.3a	157.44 ± 4.3a
A4	146.23 ± 5d	165.17 ± 5.04c	87.36 ± 2.85d	98.16 ± 2.88c
A5	217.67 ± 5.88c	229.62 ± 5.91b	128.08 ± 3.35c	134.89 ± 3.37b
A6	233.34 ± 5.94bc	245.28 ± 5.94ab	137.01 ± 3.39bc	143.82 ± 3.39ab
A7	162.06 ± 4.84d	179.84 ± 4.79c	96.39 ± 2.76d	106.52 ± 2.73c
CD	14.89	14.34	13.44	10.10
SE(m)	0.54	0.83	0.75	0.89
Rate				
L	212.72 ± 7.5a	224.96 ± 7.35a	125.26 ± 4.28a	132.24 ± 4.19a
M	215.93 ± 8.44a	228.12 ± 8.18a	127.09 ± 4.81a	134.04 ± 4.67a
H	180.74 ± 6.26b	193 ± 5.96b	107.04 ± 3.57b	114.02 ± 3.4b
CD	13.89	13.34	12.44	11.10
SE(m)	1.28	1.03	1.05	0.89
Fertiliser				
N	188.13 ± 5.81b	200.27 ± 5.61b	111.25 ± 3.31b	118.17 ± 3.2b
F	218.13 ± 6.37a	230.45 ± 6.18a	128.35 ± 3.63a	135.37 ± 3.53a
CD	13.89	14.34	11.44	9.10
SE(m)	0.29	0.73	0.55	0.89

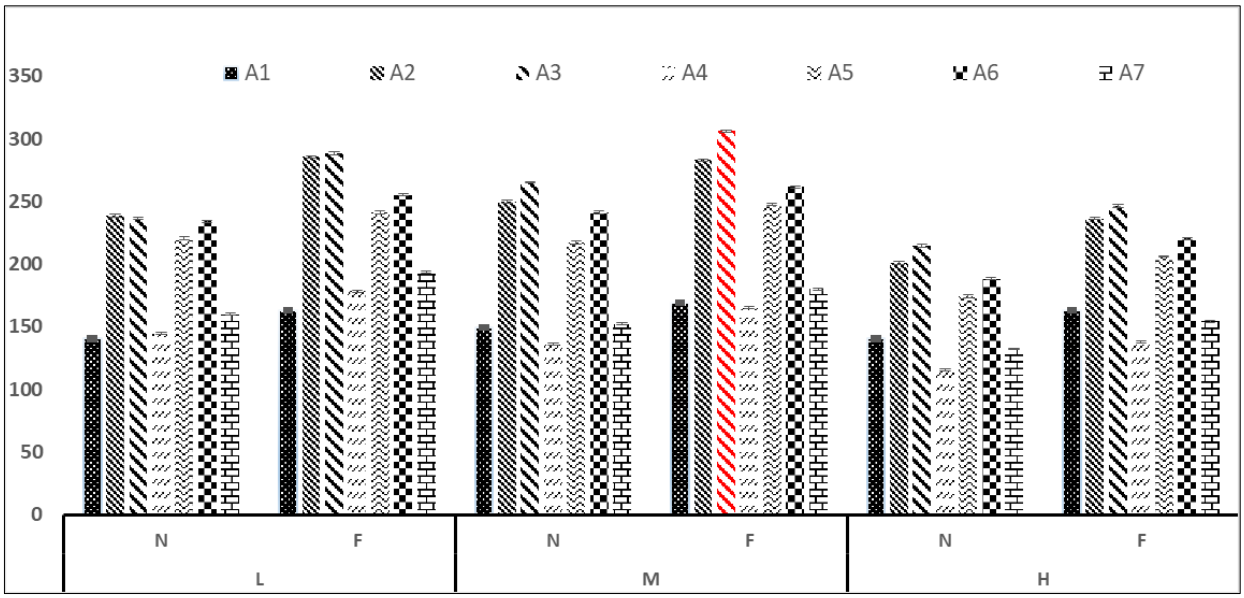

Fig 1: Plant Height as influenced by various factors

Conclusion

Apple residue derived biochar and dalweed derived biochar were both checked in field conditions. Apple residue derived biochar improved more soil physical properties and other hydrological properties than dalweed biochar, but dalweed biochar has more nutrient content. In case of physically degraded soils apple residue biochar is best suited and in nutritionally deficient soils dalweed biochar are recommended.

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