International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 2454-2457

Received: 04-11-2018
Accepted: 07-12-2018

Supriti Majhi
Department of Agronomy, OUAT, Orissa, India

Bishnupriya Patra
Department of Agronomy, OUAT, Orissa, India

SN Jena
Department of Agronomy, OUAT, Orissa, India

Correspondence
Supriti Majhi
Department of Agronomy, OUAT, Orissa, India

Effect of tillage and weed management on yield and nutrient uptake by winter maize

Supriti Majhi, Bishnupriya Patra and SN Jena

Abstract
A field experiment entitled “Tillage and weed management in winter maize” was conducted during the *rabi* season 2013 at Agronomy Research Farm, Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar. The experiment was laid out in split plot design with twenty treatments in respect of its four main plots and five sub-plots. The main plot contain four different tillage methods *i.e.* M_1 (conventional), M_2 (reduced), M_3 (zero till), and M_4 (glyphosate treated zero till). The sub-plots contain five different type of weed management practices i.e. W_1 (Atrazine@ 1.0 kg/ha), W_2 (oxyfluorfen@ 0.03 kg/ha), W_3 (metolachlor@ 1.0 kg/ha), W_4 (Two hand weedings and earthing up) and W_5 (weedy check). The removal of N, P and K by weeds (68.75, 12.03 and 108.67 kg/ha) was the highest in the weedy check treatment. The nutrient content of grain and stover of maize in oxyfluorfen treated plots were maximum. Weedy check reported the lowest value of N, P and K content as compared with weed control treatments. The highest grain yield was recorded with glyphosate treated zero tillage method followed by zero tillage and the lowest was recorded with conventional tillage.

Keywords: Maize, weed management, tillage, yield, nutrient content, nutrient uptake

Introduction

Maize is an important cereal crop in the world after wheat and rice. It is also known as “queen of cereals”. In our country maize is largely grown in Northern India. Highest concentration of crop is found in Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Himachal Pradesh, Jammu & Kashmir and Punjab which together amount for 2/3rd of the total area and output of the crop. Maize, an important crop for food and nutritional security in India, is grown in diverse ecologies and seasons covering 9.06 m ha acreage in the country (GoI 2015). Globally, it provides nearly 30% of the food calories to more than 4.5 billion peoples in 94 developing countries, and the demand of maize is expected to double worldwide by 2050 to meet this rising demand and thus higher maize production is need of the hour (Srinivasan *et al*. 2004). During past one decade (2003-04 to 2012-13), in maize area increased by 1.8%, production by 4.9% and productivity by 2.6% per annum which was mainly due to increasing maize demand in India (GoI 2015).

The conservation agriculture (CA) based crop production technologies are gaining attention in this region to explore maximum yield potential of these new SCH in maize (Ladha *et al*. 2009, Jat *et al*. 2009, Saharawat *et al*. 2012) [2, 3]. The CA based crop management practices found to be effective for increasing crop productivity (Jat *et al*. 2013, Das *et al*. 2014, Parihar *et al*. 2016) [4, 6] (1954), profitability (Parihar *et al*. 2016) [6] and energy-use efficiency (Parihar *et al*. 2011). Furthermore, the intensive traditional tillage practices led to reduction in soil organic matter because of more oxidation and breakdown of organic carbon and ultimately degrade soil properties (Biamah *et al*. 2000, Gathala *et al*. 2011) [7, 9]. Published experimental results across the globe have shown increased productivity and soil quality, mainly through SOM build-up (Ladha *et al*. 2009, Bhattacharyya *et al*. 2013) [2, 3, 10] and higher SOC content under zero-tilled compared to conventionally tilled soils (West and Post 2002, Alvarez 2005, Parihar *et al*. 2016a) [12, 8, 11].

The main drawback of maize cultivation is heavy weed infestation. The reduction in grain yield of maize by weeds was 20-40%, Panwar *et al.* (1992) [13]. The weeds emerging with the crop competing with them for nutrients especially nitrogen, grow faster and utilize it in larger amounts than the crop, resulting in poor crop yield. The weed flora associated with various methods of tillage is quite divergent. The risk of reduced corn yields by the presence of weeds in the first week or two after emergence is affected by many factors that we do not fully understand. The best way to manage this risk is the use of preemergence herbicides to minimize weeds that emerge with the crop. When pre emergence herbicides are not applied to a field, early post applications should be made as soon after corn emergence as possible if significant weed populations are present. Several pre emergence herbicides can be applied with the post product to protect the crop from weeds that germinate after the application.

Material methods

The experiment was conducted at Agronomy research farm, Department of agronomy, Odisha University of Agriculture and Technology, Bhubaneswar was carried out during *rabi* season. To study the uptake of different nutrients (N, P, K) by the maize plants and weeds, plant samples, both maize plants and weeds were collected from each plot at the time of harvest for chemical analysis. The grain and stover of the crop were kept in separate paper bags according to the treatments. Composite samples of each treatment from three replications were taken for the purpose. The samples were oven dried at 80 ^{0}C for 72 hours. Then they are processed for final grinding, passed through a 2 mm sieve and were analyzed. Nitrogen (Nessler's reagent method, Lindner, 1944) [18], phosphorus (Vanadomolybdo-phosphoric acid yellow colour method, Jackson, 1973) [17] and potassium (Flame photometer method, Richards, 1954) [19] contents in sample were analyzed.

Grain yields were recorded from the plots after final sun drying until a constant weight was obtained and converted to q/ha. The weight of plants were taken separately after removing the cobs for each plot after proper sun drying till a constant weight was obtained and is expressed in q/ha. The data obtained on various characters were averaged tabulated and analysed statistically as per split plot design analysis as suggested by Panse and Sukhatme, 1985 [15].

Table 1: Weed NPK content (%) and uptake as affected by crop establishment methods and weed management practices in maize

Treatment		Weed NPK content (%)					
		N		P		K	
		Content	Uptake	Content	Uptake	Content	Uptake
Tillage Methods(M)							
M_1	Conventional tillage	0.840	54.42	0.138	8.94	1.304	84.49
M_2	Reduced Tillage	0.821	44.65	0.136	7.40	1.299	70.65
M_3	Zero tillage	0.798	33.54	0.134	5.63	1.291	54.26
M_4	Glyphosate treated Zero-Tillage	0.783	28.89	0.132	4.85	1.284	47.19
Weed management practices(W)							
W_1	Oxyfuorfen @ 0.03Kg/ha	0.799	32.18	0.128	5.15	1.286	51.79
W_2	Atrazine @1.0 Kg/ha	0.804	32.53	0.130	5.26	1.292	52.27
W_3	Metolachlor @ 1.0 Kg/ha	0.809	33.36	0.135	5.57	1.296	53.43
W_4	Hand Weeding	0.817	34.28	0.139	5.83	1.299	54.51
W_5	Weedy check	0.823	68.75	0.144	12.03	1.301	108.67

Table 2: Grain and straw NPK content (%) as affected by crop establishment methods and weed management practices in maize

Treatment		Grain and straw NPK content (%)					
		N		P		K	
		Grain	Straw	Grain	Straw	Grain	Straw
Tillage Methods(M)							
M_1	Conventional tillage	1.265	0.434	0.368	0.184	0.281	1.413
M_2	Reduced Tillage	1.268	0.439	0.371	0.192	0.288	1.427
M_3	Zero tillage	1.270	0.442	0.378	0.197	0.295	1.433
M_4	Glyphosate treated Zero-Tillage	1.281	0.447	0.382	0.204	0.302	1.445
Weed management practices(W)							
W_1	Oxyfuorfen @ 0.03Kg/ha	1.292	0.456	0.391	0.210	0.307	1.442
W_2	Atrazine @1.0 Kg/ha	1.281	0.450	0.383	0.204	0.300	1.436
W_3	Metolachlor @ 1.0 Kg/ha	1.272	0.440	0.378	0.194	0.291	1.429
W_4	Hand Weeding	0.264	0.435	0.369	0.188	0.285	1.424
W_5	Weedy check	1.246	0.422	0.354	0.174	0.275	1.416

Table 3: Yield Characters of maize

Treatments	Grain Yield (q/ha)	Stover Yield (q/ha)	Harvest Index (%)
Tillage methods			
M_1(Conventional)	46.43	70.36	39.4
M_2(Reduced)	47.28	70.39	39.9
M_3(Zero)	50.03	72.58	40.6
M_4(glyphosate treated zero tillage)	52.72	74.63	41.2
SE(m)±	0.574	0.863	0.001
CD(p=0.05)	1.90	2.91	0.002
Weed management practices			
W_1(Oxyfluorfen@ 0.03 kg/ha)	59.48	85.18	41.1
W_2(Atrazine@ 1.0 kg/ha)	54.18	76.74	41.4
W_3(Metolachlor@ 1.0 kg/ha)	50.81	71.17	41.6
W_4(Hand weeding)	48.12	66.74	41.9
W_5(Weedy check)	32.99	60.10	35.4
SE(m)±	0.725	0.983	0.001
CD(P=0.05)	2.09	2.84	0.002

Table 4: 18 NPK uptake of maize crop

Treatment	Nitrogen (kg/ha)			Phosphorus (kg/ha)			Potassium (kg/ha)		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
Tillage methods									
M_1 (Conventional)	58.73	30.53	89.26	17.08	12.94	30.02	13.04	99.41	112.45
M_2 (Reduced)	59.95	30.90	90.85	17.54	13.51	31.05	13.61	100.44	114.05
M_3 (Zero)	63.53	32.08	95.61	18.91	14.29	33.2	14.75	104.01	118.76
M_4 (Glyphosate treated zero tillage)	67.53	33.35	100.88	20.13	15.22	35.35	15.92	107.84	123.76
Weed management practices									
W_1(Atrazine@ 1.0 kg/ha)	76.84	38.84	115.68	23.25	17.88	41.13	18.26	122.82	141.08
W_2(Oxyfluorfen@ 0.03 kg/ha)	69.40	34.53	103.93	20.75	15.65	36.40	16.25	110.19	126.44
W_3(Metolachlor@ 1.0 kg/ha)	64.63	31.31	95.94	19.20	13.80	33.00	14.78	101.70	116.48
W_4(Hand weeding)	60.82	29.03	89.85	17.75	12.54	30.29	13.71	95.03	108.74
W_5(Weedy check)	41.10	25.36	66.46	11.67	10.45	22.12	9.07	85.10	94.17

Discussion

Nutrient content and their uptake: An examination of data on nutrient content and uptake by weeds indicated that potassium content of weed was higher than nitrogen, phosphorus content was low compared with N and K content. Weedy check plot reported the maximum N, P and K content of 0.823, 0.144 and 1.301% respectively. The removal of N, P and K (68.75, 12.03 and 108.67 kg/ha) was the highest in the weedy check treatment. In tillage methods, the lowest nutrient uptake was with glyphosate treated zero tillage recording N, P and K content of 0.783, 0.132 and 1.284 % and removal of N, P and K was 28.89, 4.85 and 47.19 kg/ha respectively. Results obtained were in conformity with the findings of Srividya *et al.*, (2011) [14].

It revealed that nitrogen content of grain was around two times higher than the stover. Similarly phosphorus content in the grain was observed to be more than two fold to that of the stover, but the stover recorded five times higher potassium content. The nutrient content of grain and stover of maize in oxyfluorfen treated plots were maximum. Weedy check reported the lowest value of N, P and K content as compared with weed control treatments. Nutrient uptake of maize was presented which revealed that maximum uptake was recorded in glyphosate treated zero tillage,it was followed by zero tillage, reduced tillage and conventional tillage among weed control treatment oxyfluorfen recorded maximum nutrient uptake followed by atrazine, metolachlor and hand weeding treatments. The lowest uptake was observed in weedy check.

Grain and stover yield: The highest grain yield was recorded with glyphosate treated zero tillage method followed by zero tillage and the lowest was recorded with conventional tillage. Glyphosate treated zero tillage method was found to be significantly superior to other tillage methods. Reason for better performance of glyphosate treated zero tillage over other methods might be due to less competition between crop and weeds and high yield attributes recorded with glyphosate treated zero tillage. Among the weed management practices, oxyfluorfen was found to be significantly superior to rest of the treatments. The maximum grain yield was recorded by oxyfluorfen while the minimum was recorded by the weedy check. This might be due to maintenance of weed free environments which lead to complete utilization of nutrients and other growth factors resulting in higher yield. The results are in concordance with the findings of Nadiger (2011) [16].

The data pertaining to stover yield are presented which revealed that the stover yield was significantly influenced by tillage methods and weed management practices. The highest stover yield was recorded with glyphosate treated zero tillage method followed by zero tillage while least was recorded with conventional tillage method. Among the weed control treatments, the highest stover yield was recorded with oxyfluorfen and found significantly superior to rest of the treatments. The lowest stover yield was with weedy check. This might be due to maintenance of weed free environments which lead to complete utilization of nutrients and other growth factors resulting in vigorous crop growth and greater dry matter accumulation by the crop especially under glyphosate treated zero till method.

References

1. Saharawat YS, Ladha JK, Pathak H, Gathala M, Chaudhary N, Jat ML. Simulation of resource-conserving technologies on productivity, income and greenhouse gas (GHG) emission in rice–wheat system. Journal of Soil Science and Environment Management. 2012; 3:9-22.
2. Ladha JK, Kumar V, Alam MM, Sharma S, Gathala MK, Chandna P *et al*. Integrating crop and resource management technologies for enhanced productivity, proûtability and sustainability of the rice–wheat system in South Asia. In: Ladha, J.K., *et al.* (Eds.), Integrated Crop and Resource Management in the Rice– Wheat System of South Asia. IRRI, Los Banos, the Philippines, 2009, 69-108.
3. Jat ML, Gathala MK, Ladha JK, Saharawat YS, Jat AS, Kumar V *et al*. Evaluation of precision land levelling and double zero tillage systems in the rice–wheat rotation: water use, productivity, proûtability and soil physical properties. Soil and Tillage Research. 2009; 105:112-21.
4. Jat ML, Gathala MK, Saharawat YS, Tetarwal JP, Gupta Raj, Singh-Yadvinder. Double no-till and permanent raised beds in maize–wheat rotation of north-western Indo- Gangetic plains of India: effects on crop yields, water productivity, proûtability and soil physical properties. Field Crops Research. 2013; 149:291-99.
5. Parihar CM, Jat SL, Singh AK, Jat ML. Energy scenario and water and productivity of maize based cropping system under conservation agriculture practices in south Asia In: Abstracts of 5th world congress on conservation agriculture, incorporating the 3rd farming system design conference held at Brisbane, Australia from 26th to 29th Sept., 2011, 144-5.
6. Parihar CM, Jat SL, Singh AK, Kumar B, Yadvinder-Singh, Pradhan S *et al*. Conservation agriculture in irrigated intensive maize-based systems of north-western India: effects on crop yields, water productivity and economic profitability. Field Crops Research, 2016. http://dx.doi.org/10.1016/ j.fcr.2016.03.013.
7. Biamah EK, Rockstrom J, Okwack G. Conservation Tillage for Dryland Farming: Technological Options and

Experiences in Eastern and Southern Africa. Regional Land Management Unit, RELMA/Sida, ICRAF, House, Gigiri Nairobi, Kenya, 2000.
8. Alvarez R. A review of nitrogen fertilization and conservation tillage effects on soil C storage. Soil Use Management. 2005; 21:38-52.
9. Gathala MK, Ladha JK, Saharawat YS, Kumar V, Kumar V, Sharma PK. Effect of tillage and crop establishment methods on physical properties of a medium-textured soil under a seven-year rice–wheat rotation. Soil Science Society of America Journal. 2011; 75(1):851-62.
10. Bhattacharyya R, Das TK, Pramanik P, Ganeshan V, Saad AA, Sharma AR. Impacts of conservation agriculture on soil aggregation and aggregate- associated N under an irrigated agroecosystem of the Indo-Gangetic Plains. Nutrient Cycling in Agroecosystems, 2013. http://dx.doi.org/10.1007/s10705-013-9585- 6.
11. Parihar CM, Yadav MR, Jat SL, Singh AK, Kumar B, Pradhan S *et al*. Long term effect of conservation agriculture in maize rotations on total organic carbon, physical and biological properties of a sandy loam soil in north-western Indo-Gangetic Plains. Soil and Tillage Research 2016a; 161:116-28.
12. West TO, Post WM. Soil organic carbon sequestration rates by tillage and crop rotation: a global data analysis. Soil Science Society of America Journal. 2002; 66(1):930-46.
13. Panwar RS, Malik RK, Malik RS. Effect of weedicides on weed control in wheat (*Triticum aestivum*) crop. Indian Journal Agron. 1992; 37(2):320-323.
14. Srividya S, Chandrasekhar K, Veeraraghavaiah R. Effect of tillage and herbicide use on weed management in maize (*Zea mays.* L). The Andhra Agric. J. 2011; 58(2):123-126.
15. Panse VG, Sukhatme RV. Statistical methods for agricultural workers 4th Ed. ICAR, New Delhi, 1985.
16. Nadiger S. Bioefficacy of pre-emergent herbicides on weed management in maize, Msc thesis submitted to the University of Agricultural Sciences, Dharwad, 2011.
17. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 214-221.
18. Lindner RC. Rapid analytical methods for some of the more common inorganic constituents of plant tissues. Plant Physiology, 1944; 19:76-86.
19. Richards LA. Diagnosis and improvement of saline and alkali soils; USDA Hand Book No. 60, United State Salinity Laboratory, 1954.