Himachal Journal of Agricultural Research 49(2): 171-179 (2023)

Yield and productivity performance of cropping sequences under different production systems

Shalley, S.S. Rana, Pawan Pathania, Naveen Kumar, Pooja and Gurpreet Singh*
Department of Agronomy, College of Agriculture
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176062, India.

*Corresponding author: gurpreetpitho@gmail.com
Manuscript Received: 08.06.2023; Accepted: 04.07.2023

Abstract

The experiment was carried out at the Research farm of Department of Agronomy, College of Agriculture, CSK HPKV, Palampur during 2019-20 to 2020-21. The experiment consisted with sixteen treatments combinations having four production systems viz, integrated nutrient management, organic farming, natural farming, conservation agriculture in main plots and four cropping sequences *viz*., maize - wheat , maize + cowpea - wheat + gram, maize + soybean – radish - onion and okra + pole bean - cabbage + garden pea in sub plots. Among the production systems, highest maize equivalent yield (149.70%) was recorded under integrated nutrient management. Among the cropping sequences, okra + pole bean – cabbage + pea had highest maize grain equivalent yield (281.16%) while maize + cowpea - wheat + gram sequence resulted in lowest maize grain equivalent yield. Integrated nutrient management resulted in higher productivity (151.06 % & 150.73%) followed by organic farming and conservation agriculture while natural farming treatment gave lowest productivity. Among the cropping sequences okra + pole bean – cabbage + pea gave significantly highest productivity (396.12 % & 353.04%). Among the production systems, significantly higher value of food availability was recorded under integrated nutrient management and lowest under natural farming and among the cropping sequences significantly higher food availability was obtained in okra + pole bean – cabbage + pea (143.25 & 141.81 %) while maize + cowpea - wheat + gram resulted in lowest food availability.

Key words: Maize, natural farming, organic farming, conservation agriculture, wheat

To feed a growing population both now as well as in the future, the world faces a formidable challenge. The requirement to increase production on land already being utilized for agriculture makes this even more difficult. Competition for agricultural land is due to urbanization, dietary changes, need to produce more nutritious food, commercial use biofuel production, declining freshwater resources, future increases in fossil fuel prices and climate change influenced by greenhouse gas (GHG) emissions. The fact that farmers are already utilizing known sources of productivity growth will make this challenge even more difficult (Hobbs 2008). Systems of land management that lead to more effective utilization of natural resources must be developed. Cropping techniques used in agriculture, such as crop rotation, intercropping and crop diversification, impact soil health and quality from various temporal and spatial perspectives. Cropping systems were first created to increase the production from agro-systems; however, modern agriculture is becoming more concerned with cropping systems' environmental sustainability. Crop diversification is a key component of sustainable agricultural systems. Diversification has been proposed as a fresh approach for raising and stabilizing productivity to achieve the development of sustainable agriculture (Prasad *et al*. 2010).

Because of the versatility of cropping patterns and the capacity to fix nitrogen, legumes can offer chances for sustained increases in productivity (Jeyabal and Kuppuswamy 2001). Legume-based crop rotations contribute to the preservation of organic matter, maximization of soil nitrogen, balance of soil nutrients, maintenance of soil physical qualities and disruption of soil-borne disease cycles. Vegetables can be integrated into an established cropping system to aid in commercialization, which will increase system output, financial rewards and resource utilization. Consequently, diverse cropping systems based on legumes and vegetables have special advantages and lower the risk of low income for small and marginal farmers (Rana 2011; Sharma *et al*. 2009). Using nutrients wisely can increase vegetable yield and quality while lowering production costs (Gupta *et al*. 2006). The interplay of dietary, physiological and biochemical factors has an impact on nutritional quality of grains (Sujith *et al*. 2016). Using various nutrient management techniques affects the nutritional value of the product as well as productivity.

To ensure long-term productivity, environmental sustainability, nutrient recycling, biodiversity, etc., many production systems are used. However, the indiscriminate use of high-analysis chemical fertilizers has caused environmental degradation, which in turn has reduced soil productivity, agricultural productivity, and sustainability (Chakraborti and Singh 2008). To promote soil health and crop yield, it is crucial to implement an integrated nutrient supply system that carefully balances organic and inorganic fertilizers. To maintain soil health and crop output, integrated nutrient management has been demonstrated to be a very effective alternative to the sole application of chemical fertilizers (Bajpai *et al*. 2006). To meet the challenge mentioned above, conservation agriculture relies on three principles: minimal soil disturbance, rational soil cover using crop residues or cover crops, and crop rotation. Farmers must also use improved varieties, integrated pest, disease and weed management, integrated nutrient and water management and measures to reduce storage losses (Hobbs 2007; Hobbs *et al*., 2008). One of the most promising strategies for better usage, in addition to improving soil fertility and productivity, is crop residue retention. As customers become more health conscious and are even willing to pay greater rates for safe food, the demand for food cultivated organically is rising. Compared to legumes produced in conventionally managed fields, organically managed fields may produce more fine roots, which in turn may result in a more numerous and extensive production of nitrogen-fixing nodules. Zero Budget Natural Farming (ZBNF) is another farming practice advocated by PadamShri Dr. Subhash Palekar. This novel idea seeks to advance long-term sustainability. For sustaining the soil health and production as well as the quality of produce, the natural farming system, which uses no chemical fertilizers, and very little organic input created using the excreta and other products from indigenous ('Desi') cows, is being promoted. Therefore, the present study was conducted to evaluate the performance of cropping sequences under different production systems on yield and productivity

Materials and Methods

The present investigation was conducted during *kharif*, 2019 to *rabi*, 2020-21 at the Research farm of Agronomy Department, College of Agriculture, CSK HPKV, Palampur, located at 32.4^0 N latitude and 76.3^0 E longitudes at an elevation of about 1290 metres above mean sea level in North-Western Himalaya. The site falls in the mid-hills sub-tropical zone of Himachal Pradesh. The experiment consisted of sixteen treatment combinations of four production systems in main plots and four cropping sequences in subplots laid out in split plot design with three replications. The production system were integrated nutrient management, organic farming, natural farming and conservation agriculture. The cropping sequences were Maize - Wheat, Maize + Cowpea - Wheat + Gram, Maize + Soybean- Radish - Onion and Okra + Pole bean - Cabbage + Garden Pea. The plot size was 16.2 m^2. The recommended package of practices for the mentioned production system was used as a guide for various inputs and operations

(Anonymous 2012; Anonymous 2013). The crops were harvested when they were fully matured and ready for harvesting. The costs of the treatments were calculated by using minimum support prices and market prices for inputs and produce.

MGEY was calculated as follows:

$$\text{MGEY (kg ha}^{-1}\text{)} = \frac{\text{Economical yield of a crop}}{\text{(kg ha}^{-1}\text{)}} \times \frac{\text{Price (Rs kg}^{-1}\text{) of same crop}}{\text{Price (Rs kg}^{-1}\text{) of maize}}$$

Food availability was calculated as follows:

Food Availability (kg day^{-1}) = Total economic product from a sequence per annum/ 365

Productivity was calculated as follows:

Productivity (kg ha^{-1} day^{-1}) = Maize equivalent yield (MEY) of crop sequence/ Actual duration of crop sequence

Results and Discussion

Maize grain equivalent yield

The maize grain equivalent yield (MGEY) values under production systems and cropping sequences are presented in Table 1. In general the MGEY was higher during the second year due to higher yield of *kharif* as well as *rabi* crops which might be due to better environmental conditions because of early sowing and transplanting during the season.

Among the production systems, significantly highest MGEY was recorded under integrated nutrient management (26196 and 27906 kg ha^{-1}) for both the years 2019-20 and 2020-21. It was followed by organic farming which was statistically at par with conservation agriculture while natural farming resulted in lowest MGEY (10481 and 11185 kg ha^{-1}). The trend was similar for all the seasons during both years. Conservation agriculture produced significantly lower MGEY (17747 and 19340 kg ha^{-1}) as compared to integrated nutrient management. This may be due to poor crop establishment owing to higher mechanical resistance of soil (heavy soil structure), hindrance in seed germination because of previous crop stubbles and early crop weed competition. Certain weeds grew early because of non-killing of their root system with herbicide resulting in low plant population and growth of crops. Khaledian (2009) and Rasaily *et al.* (2012) also found lower yield under zero tillage treatment. Integrated nutrient management where some amount of nutrient requirement was supplied through FYM gave significantly more individual crop yield and thereby MGEY. Integration of inorganic with organics increases soil fertility through improvement of physical, biological and chemical properties of soil. Furthermore, combined application of FYM along with chemical fertilizers solubilizes soil nutrients thus resulting in a significant improvement in available nutrient status of soil that ultimately leads to higher crop growth and yield (Onemli 2004). Results were in confirmation with the findings of Manjhi *et al.* (2014) and Jaipaul *et al.* (2011).

Among the cropping sequences, okra + pole bean – cabbage + pea had significantly higher MGEY (32629 and 33389 kg ha^{-1}) followed by maize + soybean – radish – onion and maize – wheat. Maize + cowpea - wheat + gram sequence resulted in lowest MGEY. Cabbage had highest MGEY among all crops in various crop sequences and it was followed by pea than rest of the crops. Higher MGEY in vegetable-based sequences might be due to more production of vegetable crops and their higher remunerative prices in the market. It was also observed that as the cropping intensity increased, MGEY also increased; hence minimum MGEY was recorded under cropping sequence whose cropping intensity was 200 % (maize-wheat). Rana *et al.* (2011) have also reported that maize-based crop sequences involving vegetable crops yielded higher equivalent yields than cereal-cereal crop sequences. Similarly, Shivay *et al.* (2001) reported that sequences involving legumes as intercrop in maize crop also increased the MGEY as compared to sole cropping of maize.

Production systems as well as cropping sequences brought about significant variation in MGEY in pooled over years. Integrated nutrient management resulted in an increase in MGEY to the tune of 149.70%, organic farming by 78.52% and conservation agriculture by 71.17% over that obtained

Table 1. Effect of production systems and cropping sequences on MGEY (kg ha^{-1})

Treatment	MGEY (kg ha^{-1})												
	2019-20						2020-21						
	Kharif	*Intercrop*	*Rabi 1*	*Intercrop*	*Rabi 2*	Total	*Kharif*	*Intercrop*	*Rabi 1*	*Intercrop*	*Rabi 2*	Total	*Pooled*
Production system													
Integrated nutrient management	4836	2106	10452	4127	4674	26196	5058	1991	11719	4243	4895	27906	27051
Organic farming	4082	1255	6877	3228	3156	18599	4365	1216	7990	3293	3217	20081	19340
Natural farming	2595	567	4287	1661	1371	10481	2566	646	4767	1702	1505	11185	10833
Conservation agriculture	4065	1211	6100	3261	3110	17747	4395	1196	7222	3434	3093	19340	18543
SEm±	-	-	-	-	-	326	-	-	-	-	-	514	408
LSD (P=0.05)	-	-	-	-	-	1128	-	-	-	-	-	1780	1411
Cropping sequences													
Maize - wheat	4520	-	4535	-	-	9055	4681	-	4829	-	-	9510	9282
Maize + cowpea - wheat + gram	3151	942	3410	795	-	8297	3314	1299	3595	816	-	9024	8660
Maize + soybean - radish - onion	3238	547	6946	-	12311	23042	3326	673	9881	-	12709	26589	24816
Okra + Pole bean - cabbage + pea	4670	3651	12826	11483	-	32629	5064	3075	13394	11856	-	33389	33009
SEm±	-	-	-	-	-	385	-	-	-	-	-	436	398
LSD (P=0.05)	-	-	-	-	-	1125	-	-	-	-	-	1272	1163

in natural farming. Among cropping sequences, okra + pole bean – cabbage + pea increased MGEY by 281.16 %, maize + soybean – radish - onion increased by 186.55 % while maize + cowpea - wheat + gram cropping sequence by 7.18 % over the conventional maize-wheat system.

The data pertaining to interaction effect of production system and cropping sequences on MGEY have been presented in Table 2. The interaction table revealed that for both the years 2019-20 and 2020-21 under each production system, okra + pole bean – cabbage + pea resulted in significantly highest MGEY followed by maize + soybean – radish – onion. While, maize – wheat and maize + cowpea - wheat + gram cropping sequences were statistically equal in influencing MGEY. Among all combinations of cropping sequences and production systems, okra + pole bean – cabbage + pea under integrated nutrient management had highest MGEY and was followed by maize + soybean – radish – onion under integrated nutrient management and okra + pole bean – cabbage + pea under organic production system during both the years. Maize + cowpea - wheat + gram under natural farming remaining at par with maize – wheat under natural farming had significantly lower MGEY over other combinations.

Table 2. Interaction effect of different production systems and cropping sequences on MGEY (kg ha^{-1})

Cropping sequence	Production Systems			
	P_1	**P_2**	**P_3**	**P_4**
		2019-20		
C_1	10525	8590	7172	9933
C_2	10054	8384	5554	9196
C_3	35413	23173	11180	22402
C_4	48791	34249	18019	29458
		2020-21		
C_1	11025	9130	7700	10185
C_2	11002	9389	5845	9860
C_3	40479	26960	13268	25649
C_4	49119	34844	17929	31665

LSD (P=0.05)

	2019-20	**2020-21**
For comparison of four crops (sub plot levels) at the same levels of production system (main level)	2250	2544
For comparison of different production system at the same or different levels of crops	2274	2869

Production Systems: - P_1: Integrated nutrient management, **P_2**: Organic farming, **P_3**: Natural farming, **P_4**: Conservation agriculture.

Cropping sequences:- C_1:Maize - wheat, C_2:Maize + cowpea - wheat + gram, C_3:Maize + soybean - radish - onion, C_4: Okra + Pole bean - cabbage + pea

Food availability

The data regarding per day main product availability referred to as food availability have been presented in Table 3. An appraisal of the data shows significant influence of production systems and cropping sequences on food availability during both the years (2019-20 and 2020-21). Among the production systems, significantly higher value was recorded under integrated nutrient management and lowest under natural farming during both years. Higher food availability under integrated nutrient management was due to higher MGEY under integrated nutrient management as compared to other production systems.

Among the cropping sequences tested significantly higher food availability was obtained in okra + pole bean – cabbage + pea (143.25 & 141.81 %) which was followed by maize + soybean – radish – onion and maize – wheat while maize + cowpea - wheat + gram resulted in significantly lowest food availability for both the years. Introducing vegetables like okra + pole bean – cabbage + pea in the sequence resulted in higher yield which leads to higher food availability. Maize + cowpea - wheat + gram resulted in lowest

Table 3. Effect of production systems and cropping sequences on food availability (kg day^{-1}) and productivity (kg ha^{-1} day^{-1})

	Food availability (kg day^{-1})		Productivity (kg ha^{-1} day^{-1})	
	2019-20	2020-21	2019-20	2020-21
Production systems				
Integrated nutrient management	52.3	56.1	94.4	102.3
Organic farming	37.1	40.6	67.0	73.5
Natural farming	21.5	23.2	37.6	40.8
Conservation agriculture	35.2	38.9	63.4	70.5
SEm±	0.56	1.01	1.24	1.96
LSD (P=0.05)	1.93	3.51	4.29	6.78
Cropping sequences				
Maize - wheat	21.8	22.9	31.9	33.4
Maize + cowpea - wheat + gram	17.4	18.7	25.8	29.6
Maize + soybean - radish - onion	45.5	54.5	76.8	90.1
Okra + Pole bean - cabbage + pea	61.3	62.8	128.0	134.1
SEm±	0.73	0.85	1.44	1.67
LSD (P=0.05)	2.13	2.48	4.21	4.88

food availability because of lower economic yield of the system during both years.

Perusal of data (Table 4) indicated a significant interaction effect of production system and cropping sequences on per-day food availability. The data revealed that under each production system, okra + pole bean – cabbage + pea resulted in significantly highest per day food availability and it was followed by maize + soybean – radish – onion. In organic production system maize – wheat and maize + cowpea - wheat + gram cropping sequences were statistically at par with each other. Among all the combinations of cropping sequences and production system, integrated nutrient management with okra + pole bean – cabbage + pea had resulted in significantly highest food availability which was followed by maize + soybean – radish – onion during both years. Natural farming with maize + cowpea - wheat + gram resulted in lowest food availability during both the years. However, in 2020-21, maize - wheat and maize + cowpea - wheat + gram were at par with each other in all production system except natural farming production system

Productivity

A perusal of the data on effect of production systems and cropping sequences on productivity (Table 3) showed significant influence of both factors. Integrated nutrient management resulted in significantly highest productivity followed by organic farming system which was statistically at par with conservation agriculture during both years (2019-20 and 2020-21). Higher productivity under integrated nutrient management was due to higher MGEY as compared to other production systems. The natural farming treatment gave significantly lowest productivity for both years.

Among the cropping sequences okra + pole bean – cabbage + pea gave significantly highest productivity during both the years of study. It was followed by maize + soybean – radish – onion and maize – wheat while maize + cowpea - wheat + gram resulted in lower productivity during both years. Higher productivity

Table 4.Interaction effect of production systems and cropping sequences on food availability (kg day^{-1})

Cropping sequence	Production Systems			
	P_1	P_2	P_3	P_4
	2019-20			
C_1	25.4	20.6	17.3	23.9
C_2	20.9	17.7	11.7	19.4
C_3	70.2	45.5	22.8	43.4
C_4	92.4	64.6	34.3	54.0
	2020-21			
C_1	26.6	21.8	18.5	24.6
C_2	22.3	19.5	12.4	20.5
C_3	82.6	55.3	27.8	52.2
C_4	93.0	65.9	33.9	58.5

LSD(P=0.05)

	2019-20	2020-21
For comparison of four crops (sub plot levels) at the same levels of production system (main level)	4.26	4.95
For comparison of different production system at the same or different levels of crops	4.20	5.61

Production Systems:-P_1: Integrated nutrient management, **P_2**: Organic farming, **P_3**: Natural farming, **P_4**: Conservation agriculture.

Cropping sequences:- C_1:Maize - wheat,**C_2**:Maize + cowpea - wheat + gram,**C_3**:Maize + soybean - radish - onion, C_4: Okra + Pole bean - cabbage + pea under okra + pole bean – cabbage + pea crop sequence was owed due to higher MGEY of the system. Further, higher cost of the produce *viz*., okra, pole bean, cabbage and pea resulted in higher MGEY and thereby productivity of the system. Similar results were obtained by Sharma *et al*. (2008) in a study of rice-based crop sequences where crop sequences involving onion, potato and other vegetable crops gave higher production efficiency than rice–wheat sequence. Chaudhary *et al*. (2001) obtained similar findings with diversified cropping systems over traditional maize–wheat sequence.

Cropping sequences interacted significantly with production systems in bringing about variation in productivity during both years (Table 5). Under all production systems, okra + pole bean – cabbage + pea had significantly highest productivity in both years followed by maize + soybean – radish – onion cropping sequence. Whereas, the lowest productivity was recorded in the maize + cowpea - wheat + gram cropping sequence. The maize - wheat and maize + cowpea - wheat + gram were statistically at par in both years of study. Compared to other treatment combinations during both years, integrated nutrient management with okra + pole bean – cabbage + pea had resulted in significantly highest productivity followed by organic farming system along with okra + pole bean – cabbage + pea and integrated nutrient management with maize + soybean - radish - onion. Natural farming along with maize + cowpea - wheat + gram resulted in lowest productivity.

It can be concluded from the present study that integrated nutrient management and conservation agriculture production practices can be more productive, remunerative and energy efficient as compared to natural farming. Further, vegetable based

Table 5. Interaction effect of production systems and cropping sequences on productivity (kg ha^{-1} day^{-1})

Cropping sequence	Production Systems			
	P_1	**P_2**	**P_3**	**P_4**
		2019-20		
C_1	37.1	30.2	25.3	35.0
C_2	31.2	26.0	17.2	28.6
C_3	118.0	77.2	37.3	74.7
C_4	191.3	134.3	70.7	115.5
		2020-21		
C_1	38.7	32.0	27.0	35.7
C_2	36.1	30.8	19.2	32.3
C_3	137.2	91.4	45.0	86.9
C_4	197.3	139.9	72.0	127.2

LSD(P=0.05)	2019-20	2020-21
For comparison of four crops (sub plot levels) at the same levels of production system (main level)	8.42	9.76
For comparison of different production system at the same or different levels of crops	8.54	10.98

Production Systems:-P_1: Integrated nutrient management, **P_2**: Organic farming, **P_3**: Natural farming, **P_4**: Conservation agriculture.

Cropping sequences:- **C_1**: Maize - wheat, **C_2**:Maize + cowpea - wheat + gram,**C_3**: Maize + soybean - radish - onion, **C_4**: Okra + Pole bean - cabbage + pea sequence *viz*. okra + pole bean – cabbage + garden pea was found more beneficial in terms of tonnage and monetary gains.

Conflict of interest: The authors have no conflict of interest in this research paper.

References

Anonymous. 2012. Package of Practices for *Kharif* Crops. Directorate of Extension Education, CSKHPKV, Palampur.

Anonymous. 2013. Package of Practices for Vegetable Crops. Directorate of Extension Education, CSKHPKV, Palampur.

Bajpai RK, Chitale S, Upadhyay SK and Urkurkar JS. 2006. Long-term studies on soil physico-chemical properties and productivity of rice-wheat system as influenced by integrated nutrient management in inceptisol of Chhattisgarh. Journal of Indian Society of Soil Science **54**: 24-29.

Chakraborti D and Singh EJ. 2008. Biological nitrogen fixation in faba-beans in highlands as affected by P fertilization and inoculation. Environment Geology **56**: 381–390.

Chaudhary JB, Thakur RC, Bhargava M and Sood RD. 2001. Diversification of traditional cropping systems for sustainable productivity on farmers fields under rainfed ecosystem. Himachal Journal of Agricultural Research **27**: 7-10.

Gupta V, Sharma RS and Vishvakarma SK. 2006.Long-term effect of integrated nutrient management on yield sustainability and soil fertility of rice-wheat cropping system. Indian Journal of Agronomy **51**: 160-164.

Hobbs PR 2007. Conservation agriculture: what is it and why is it important for future sustainable food production? The Journal of Agricultural Science **145** (02): 127-137.

Jaipaul, Sharma S, Dixit AK and Sharma AK 2011. Growth and yield of capsicum (*Capsicum annum*) and garden pea (*Pisum sativum*) as influenced by organic manures and biofertilizers. Indian Journal of Agricultural Sciences **81**: 637-642.

Jeyabal A and Kuppuswamy G. 2001. Recycling of organic wastes for the production of vermicompost and its response in rice–legume cropping system and soil fertility. European Journal of Agronomy **15** (3): 153–170.

Khaledian MR. 2009. Evaluation de la technique du semis direct en culture irriguée en comparaison avec le système de culture conventionnel [dissertation]. Montpellier: University of Montpellier II.

Manjhi RP, Yadava MS and Thakur R. 2014. Effect of integrated nutrient management on crop productivity and changes in soil fertility in maize (*Zea mays*)–wheat (*Triticum aestivum*) cropping sequence. Indian Journal of Agronomy **59**: 371-376.

Onemli F. 2004. The effects of soil organic matter on seedling emergence in sunflower (*Helianthus annuus* L.). Plant, Soil and Environment **50**: 494–499.

Prasad J, Karmakar S, Kumar R and Mishra B. 2010. Influence of integrated nutrient management on yield and soil properties in maize-wheat cropping system in an Alfisol of Jharkhand. Journal of the Indian Society of Soil Science **58** (2): 200-204.

Rana SS, Sharma HL, Subehia SK, Negi SC and Sharma SK 2011. Promising cropping systems for mid hill agro climatic conditions of Himachal Pradesh. Himachal Journal of Agricultural Research **37**: 138-148.

Rasaily RG, Li H, He J, Wang Q and Lu C. 2012. Influence of no tillage controlled traffic system on soil physical properties in double cropping area of North China plain. African Journal of Biotechnology **11**: 856-864.

Sharma P, Abrol V, Maruthi GR, Sankar and Singh B. 2009. Influence of tillage practices and mulching options on productivity, economics and soil physical properties of maize (*Zea mays*)–wheat (*Triticum aestivum*) system. Indian Journal of Agricultural Sciences **79**: 865-870.

Sharma SK, Rana SS, Sharma S, Subehia SK, Sharma JJ and Sharma HL. 2008. Production potential and economic feasibility of rice-based cropping sequences on cultivator’s fields under sub-mountain low-hills of Himachal Pradesh. Himachal Journal of Agricultural Research **34**: 5-9.

Shivay YS, Singh RP and Pal M. 2001. Productivity and economics of maize as influenced by intercropping with legumes and nitrogen levels. Annals of Agricultural Research New Series **22**: 576-582.

Sujith GM, Sudhir K and Shivraj B. 2016. Grain yield and quality parameters of maize (*Zea mays* L.) as influenced by manuring and fertilization in finger millet-maize crop sequence of Alfisols of Karnataka. International Journal of Advanced Biological Research **6** (2): 306-308.