Vol-07 Issue 09, September-2023 ISSN: 2456-9348
Impact Factor: 6.736

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

RESIDUAL EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON GROWTH ATTRIBUTES OF CHICKPEA

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ABSTRACT
A field study was conducted during two continuous seasons of 2013-14 and 2014-15 at RCA, MPUAT, Udaipur. The results revealed that the residual effect of integrated nitrogen management on chickpea growth and yield attributes in terms of height of plat, number of primary branches plant^{-1} and accumulation of dry matter plant^{-1} and number of pods plant^{-1}, grains pod^{-1}, grain yield plant^{-1}, grains plant^{-1} and 100-grain weight brought about increased by application of 75% N via chemical fertilizer + 25% N via vermicompost + *Azotobacter* & PSB which was significantly superior over 100% N via chemical fertilizer alone but at par with 75% N via chemical fertilizer + 25% N via FYM + *Azotobacter* & PSB, 75% N via chemical fertilizer + 25% N via vermicompost and 75% N via chemical fertilizer + 25% N via FYM.

INTRODUCTION
Sorghum – chickpea is an important cropping system followed in Southern Rajasthan. In this system fertilizer N, a costly input is regularly applied by synthetic fertilizer, resulting in poor productivity of one or both the crops. Information regarding efficiency of component crops of aforesaid cropping system to utilize organic manures and synthetic fertilizer to produce economic yields would help minimize the expenditure on nutrient application [1].
The use of appropriate fertilizer is thought to be the most crucial among the different agronomic parameters affecting crop productivity in order to attain potential and desired crop yield. However, the use of this crucial resource is constrained by the detrimental effects of synthetic nutrient sources on soil health, the energy crisis, the expensive cost of synthetic fertilizers, and the poor economic condition of small and marginal farmers.
So it's time to develop a plan to maximize the use of manures/compost and chemical fertilizers together with the right technologies to increase crop yield. Nitrogen is one of the important nutrients that is consistently deficient in most of Indian soils. Nitrogen is a crucial component of chlorophyll, which gives plants their dark green color and is a necessary component of amino acids. It increases plant growth and the synthesis of the protein units. It encourages shoot enlargement, tillering, and after defoliation its regeneration and enhances the use of phosphorus and potassium, and microelements to a significant extent in the plant. The sorghum crop exhausts a higher amount of nutrients than other forage crops, and because it is a cereal crop, it requires more nutrients for higher productivity.
In terms of plant nutrition, a soil's organic matter content is the crucial factor that determines the availability of major nutrients. It is generally known that organic materials contribute to maintain and improves soil fertility. To increase the production, soil must maintain the optimal level of organic matter. Even while maximum production may be attained by using synthetic fertilizers more frequently, this may cause pollution issues and a decline in the organic carbon and fertility of the field. By using organic compost/manures this can be kept up at a sustainable level.
In terms of plant nutrition, a soil's content of organic matter is the primary factor determining the availability of vital nutrients. It is generally known that organic materials play a crucial part in maintaining and improving soil fertility. To maintain productivity, soil organic matter must be kept at its ideal level. Increased use of chemical fertilizers alone can boost productivity, but it may also cause environmental issues and deteriorate soil properties like organic carbon and soil fertility. Applying organic manures is the only way to keep this at a sustainable level. Vermicompost is currently gaining a lot of attention, and its utilization has become an important component of integrated plant nutrition management [2]. Earthworms are soil cultivators and recyclers of organic nutrients. The presence of earthworms in the field is a sign of the presence of other soil fauna that contributes to soil fertility. One of the most significant advances in biological research is the discovery that earthworms that can break down organic wastes [3]. According to the limited research that has been done on vermicompost, it enhances macro pore space, which improves the air-water relationship. Vermicompost application shows positive impacts on soil pH, microbial population, and enzyme activity [4]. Animal-based manures not only enhance soil quality and plant

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growth, but also have a positive impact on soil fertility. In this regards, poultry manure takes a pride position because it contains more nutrients than other manures [5]. Poultry litter serves as a significant source of nitrogen, phosphorus, and trace elements for crop productivity and has been shown to improve physical and biological fertility and land application is still the primary method of utilizing this available resource [6].

As a comparison of chemical fertilizers, bio-fertilizers are cheaper, pollution free and renewable source of plant nutrients. Besides providing nutrients, it also added organic matter in the soil to prevent it from deterioration. *Azotobacter* are free living, abiotic soil microbes which play an important role in the nitrogen cycle, binds atmospheric nitrogen which is directly not available to plants. Application of *Azotobacter* has been found to reduce the requirement of chemical fertilizer upto 50 percent [7]. Phosphorus solubilizing bacteria (PSB) play an important role in converting insoluble phosphate chemically fixed soil phosphorus into the available form, resulted in higher crop yield [8]. Among the whole microbial population present in the field, PSB constitute 1 to 50 per cent in P solubilization potential [9].

In the recent past, nutritional recommendations were based on single crop that too emphasized on chemical fertilizers. Residual effect of previous crop and their fertilization especially nitrogen on succeeding crop has been generally ignored. Since cereal in different cropping systems and nitrogen applied to them by organic manures have a marked effect on the nitrogen status of soil rich in total nitrogen and refers as carry over benefits to succeeding crop because one third of nitrogen content of organic manures are utilized by current season crop and rest is usually available to successive crop [10]. This signifies the importance of considering cropping system as a whole for nitrogen management.

MATERIALS AND METHODS

A field study entitled "Integrated Nitrogen Management in Sorghum [*Sorghum bicolor* (L.) Moench] and its Residual Effect on Chickpea" was conducted during year 2013-14 and 2014-15. The condition of the soil of field was clay loam in texture with slightly alkaline reaction (pH 8.15 to 7.07), available nitrogen was low (271.40 and 275.70 kg ha^{-1}), medium in available phosphorus (19.60 and 20.20 kg ha^{-1}) and available potassium was higher (286.52 and 292.80 kg ha^{-1}). The experiments consisted of 14 treatment combinations and these were tree replication with Randomised Block Design and the treatments were 100% RDN via synthetic fertilizer, 50% RDN via synthetic fertilizer + 50% RDN via FYM, 75% RDN via synthetic fertilizer + 25% RDN via FYM, 50% RDN via synthetic fertilizer + 50% RDN via vermicompost, 75% RDN via synthetic fertilizer + 25% RDN via vermicompost, 50% RDN via synthetic fertilizer + 50% RDN via poultry manure, 75% RDN via synthetic fertilizer + 25% RDN via poultry manure, 50% RDN via synthetic fertilizer + 25% FDN via FYM + 25% RDN via vermicompost, 50% RDN via synthetic fertilizer + 25% RDN via FYM + 25% RDN via poultry manure, 50% RDN via synthetic fertilizer + 25% RDN via vermicompost + 25% RDN via poultry manure, 75% RDN via synthetic fertilizer + 25% RDN via FYM + seed treated with biofertilizer, 75% RDN via synthetic fertilizer + 25% RDN via vermicompost + PSB + Azotobacter, 75% RDN via synthetic fertilizer + 25% RDN via poultry manure + biofertilizer and 75% RDN via synthetic fertilizer + biofertilizer.

RESULT AND DISCUSSION

Growth parameters

Data (Table 1 - 2) showed that integrated nitrogen management practices to preceding sorghum crop had a residual effect on succeeding chickpea crops during both years. Chickpea crop under the residual effect of 75% N via chemical fertilizer + 25% N via vermicompost + *Azotobacter* & PSB attained significant maximum height of plant and dry matter accumulation at different crop growth stages over the rest of treatments but at par with 75% N via chemical fertilizer + 25% N via FYM + *Azotobacter* & PSB, 75% N via chemical fertilizer + 25% N via vermicompost and 75% N via chemical fertilizer + 25% N via FYM during both the years. This could have boosted meristematic processes, enhancing cell proliferation, enlargement, and elongation, leading to taller plants. Several researches have noted the favorable impact of organic fertilizers used on previous crops on chickpea growth. [11][12].

Yield attributes

The data depicted in Table 3 and 4 revealed that crop produced under residual effect of 75% N via chemical fertilizer + 25% N via vermicompost + seed treatment with *Azotobacter* & PSB significantly improved branches plant^{-1}, pods plant^{-1}, numbers of grains pod^{-1}, number of grains plant^{-1} and 100 seeds weight over remained INM treatments during both the years and pooled analysis but remained statistically at par with 75% N via chemical fertilizer + 25% N via FYM + *Azotobacter* & PSB, 75% N via chemical fertilizer + 25% N via vermicompost and 75% N via chemical fertilizer + 25% N via FYM. The remarkable increase in various yield attributes with the

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residual effect of integrated nitrogen management can be imposed not only on the optimum supply of essential elements but also on the pivotal role of organic manures in improving physico-chemical and biological properties of soil, thereby enhancing root growth and synthesis of cytokinnins. The results of present investigation indicating positive response of various yield attributes to residual integrated nitrogen management corroborate with the findings of [13] [14][15].

CONCLUSION

Based on the results of present study it may concluded that under sorghum-chick pea cropping system should be fertilized with 75% N via chemical fertilizer + 25% N via vermicompost/FYM + seed treatment with *Azotobacter* & PSB.

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Table 1. Residual effect of integrated nitrogen management on height and branches at harvest of chickpea

Treatment	Plant height (cm)			Branches plant^{-1}		
	2014	2015	Pooled	2014	2015	Pooled
100 RDF CF	49.25	49.54	49.40	4.05	4.15	4.10
50 CF + 50 FYM	53.41	52.89	53.15	4.87	4.83	4.85
75 CF + 25 FYM	54.36	55.11	54.74	5.71	5.75	5.73
50 CF + 50 VC	53.45	53.74	53.60	5.45	5.38	5.42
75 CF + 25 VC	55.45	55.38	55.42	5.80	5.91	5.86
50 CF + 50 PM	51.92	51.73	51.83	4.38	4.35	4.37
75 CF + 25 PM	51.56	51.59	51.58	4.10	4.22	4.16
50 CF + 25 FYM + 25 VC	52.57	53.27	52.92	5.38	5.24	5.31
50 CF + 25 FYM + 25 PM	52.04	52.86	52.45	4.83	4.79	4.81
50 CF + 25 VC + 25 PM	52.08	52.87	52.48	4.87	4.79	4.83
75 CF + 25 FYM + BF	56.49	56.12	56.31	5.86	5.92	5.89
75 CF + 25 VC + BF	58.02	57.69	57.85	6.11	6.16	6.13
75 CF + 25 PM + BB	50.97	51.91	51.44	4.50	4.47	4.49
75 CF + BF	48.52	49.15	48.83	3.41	3.56	3.49
SEm±	1.40	1.31	0.83	0.20	0.18	0.12
CD 5%	4.08	3.79	2.36	0.57	0.53	0.33

Table 2. Residual effect of integrated nitrogen management on dry matter production (g plant^{-1}) of chickpea

Treatment	50 DAS			At harvest		
	2014	2015	Pooled	2014	2015	Pooled
100 RDF CF	5.12	4.94	5.03	13.31	13.37	13.34
50 CF + 50 FYM	5.47	5.48	5.48	14.80	14.83	14.82
75 CF + 25 FYM	6.71	6.67	6.69	16.15	15.87	16.01
50 CF + 50 VC	6.31	6.33	6.32	15.37	15.46	15.41
75 CF + 25 VC	6.84	6.81	6.82	16.56	16.81	16.69
50 CF + 50 PM	5.17	5.20	5.19	13.89	14.10	14.00
75 CF + 25 PM	5.02	5.18	5.10	14.49	14.95	14.72
50 CF + 25 FYM + 25 VC	6.17	6.20	6.19	14.78	15.27	15.03
50 CF + 25 FYM + 25 PM	5.26	5.31	5.29	14.72	14.70	14.71
50 CF + 25 VC + 25 PM	5.41	5.36	5.39	14.47	15.14	14.81
75 CF + 25 FYM + BF	7.05	6.89	6.97	16.84	16.99	16.91
75 CF + 25 VC + BF	7.24	7.29	7.27	17.05	17.20	17.13
75 CF + 25 PM + BB	5.23	5.30	5.27	14.24	15.33	14.79
75 CF + BF	4.97	4.88	4.92	13.05	13.31	13.18
SEm±	0.22	0.32	0.17	0.50	0.57	0.33
CD 5%	0.63	0.92	0.47	1.46	1.67	0.94

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Table 3. Residual effect of integrated nitrogen management on yield tributes of chickpea

Treatment	Branches plant^{-1}			Pods plant^{-1}			Grains pod^{-1}		
	2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
100 RDF CF	4.05	4.15	4.10	39.65	42.14	40.90	1.49	1.54	1.52
50 CF + 50 FYM	4.87	4.83	4.85	41.09	41.85	41.47	1.55	1.49	1.52
75 CF + 25 FYM	5.71	5.75	5.73	42.79	43.20	43.00	1.71	1.70	1.70
50 CF + 50 VC	5.45	5.38	5.42	42.35	42.56	42.46	1.56	1.52	1.54
75 CF + 25 VC	5.80	5.91	5.86	43.43	43.63	43.53	1.73	1.74	1.74
50 CF + 50 PM	4.38	4.35	4.37	39.58	40.45	40.01	1.44	1.41	1.43
75 CF + 25 PM	4.10	4.22	4.16	39.15	40.20	39.67	1.42	1.36	1.39
50 CF + 25 FYM + 25 VC	5.38	5.24	5.31	42.11	42.64	42.37	1.58	1.62	1.60
50 CF + 25 FYM + 25 PM	4.83	4.79	4.81	40.85	41.51	41.18	1.49	1.45	1.47
50 CF + 25 VC + 25 PM	4.87	4.79	4.83	40.88	41.66	41.27	1.50	1.49	1.50
75 CF + 25 FYM + BF	5.86	5.92	5.89	44.69	45.81	45.25	1.75	1.75	1.75
75 CF + 25 VC + BF	6.11	6.16	6.13	45.11	46.33	45.72	1.78	1.77	1.77
75 CF + 25 PM + BB	4.50	4.47	4.49	40.80	41.43	41.12	1.48	1.47	1.48
75 CF + BF	3.41	3.56	3.49	37.96	38.20	38.08	1.20	1.31	1.26
SEm±	0.20	0.18	0.12	0.90	1.16	0.64	0.03	0.04	0.02
CD 5%	0.57	0.53	0.33	2.61	3.38	1.81	0.10	0.12	0.06

Table 4. Residual effect of integrated nitrogen management on grains plant^{-1} and test weight of chickpea

Treatment	Grains plant^{-1}			Test weight (g)		
	2014	2015	Pooled	2014	2015	Pooled
100 RDF CF	50.37	51.05	50.71	151.60	152.48	152.04
50 CF + 50 FYM	55.02	54.87	54.95	152.47	154.73	153.60
75 CF + 25 FYM	56.53	56.71	56.62	173.34	174.06	173.70
50 CF + 50 VC	55.67	55.68	55.68	158.19	162.15	160.17
75 CF + 25 VC	57.66	57.75	57.71	175.28	175.66	175.47
50 CF + 50 PM	50.30	50.82	50.56	134.96	135.61	135.29
75 CF + 25 PM	48.62	49.79	49.21	132.85	136.67	134.76
50 CF + 25 FYM + 25 VC	52.69	56.09	54.39	156.99	159.89	158.44
50 CF + 25 FYM + 25 PM	50.88	51.33	51.10	141.39	144.87	143.13
50 CF + 25 VC + 25 PM	51.66	50.75	51.20	146.97	150.92	148.95
75 CF + 25 FYM + BF	59.63	59.83	59.73	175.84	177.50	176.67
75 CF + 25 VC + BF	59.54	59.99	59.77	176.28	177.88	177.08
75 CF + 25 PM + BB	49.06	49.81	49.43	135.88	141.05	138.47
75 CF + BF	45.27	45.12	45.19	127.01	124.87	125.94
SEm±	1.30	1.43	0.84	5.02	4.60	2.95
CD 5%	3.77	4.16	2.37	14.59	13.36	8.36