ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2521-0912 (Print)
ISSN: 2521-0513 (Online)
CODEN: JCOLBF

Journal Clean WAS (JCleanWAS)

DOI: http://doi.org/10.26480/jcleanwas.01.2020.32.35

RESEARCH ARTICLE

EFFECT OF INTEGRATED MANAGEMENT OF FYM AND UREA IN CABBAGE GROWN ON CLAY LOAM SOIL, DANG, NEPAL

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ARTICLE DETAILS

Article History:

Received 12 July 2020
Accepted 14 August 2020
Available online 8 September 2020

ABSTRACT

A field experiment was conducted at the field of CAMPUS OF LIVE SCIENCES, Dang having clay loam soil to evaluate effect of integrated management of FYM and urea in cabbage. This experiment was carried out in Randomized Complete Block Design (RCBD) having six treatments with three replications. Golden Ball variety of cabbage was selected for this research as a test crop. The application of FYM and urea shows significant result on the plant height, number of leaves, length of plant, head diameter and biomass yield. The maximum head diameter was observed in treatment 50%FYM +50% UREA (14.31cm).The highest biological yield (9.63Mt/ha) and highest economic yield (6.16Mt/ha) was obtained from treatment 50%UREA +50 %FYM which was similar with recommend rate of fertilizer for cabbage. The highest soil pH (6.40), soil moister content (40.46%), the lowest bulk density (1.12g/cm^3) was obtained from FYM application. The highest organic matter content (1.46) was also observed from FYM application. The most of the soil properties were enhanced by application of FYM and UREA. Furthermore, FYM played important role in maintaining soil physical property. In addition, this study indicates the possibility of FYM application to reduce nutrient risk by enhancing physio-chemical properties of clay loam soil. This result will helpful for the student and scientists in further research to increase the productivity and for the improvement of soil property.

KEYWORDS

Cabbage, Farm yard manure, Fertilizer, Biomass, Production and harvesting index.

1. INTRODUCTION

Cabbage (*Brasicca oleracea var. capitata* L.) is a green leafy vegetable crop, belonging to the cruciferae family originating from the South and Western part of Europe. Cabbage is well known for its nutritional importance. It is rich in vitamins like A, B1, B2 & C, also contains minerals like P, K, Na, Fe, fats and protein. Cabbage provides cooling effect; aids in digestion which helps to prevent constipation and also helps to prevent diabetic problems. Cabbage is a cole crop which flourishes well in cool moist climate. It can be grown on a wide range of soils but it thrives on well-drained, moisture-retentive loamy soils well supplied with organic matter.

Cabbage is a geacy feeder and requires higher amount of plant nutrients particularly nitrogen for head (edible part of cabbage) production. Nitrogen supply resulted in more chlorophyll content which accelerated the photosynthetic rate and there by increased the supply of carbohydrate. The better availability of nitrogen also favoured the metabolic and auxin activities, vegetative growth, head weight, TSS, dry matter per cent and head diameter (Meena and Paliwal, 2003). However, excess supply of nitrogen through inorganic fertilizers has adverse effect on the quality of head. It produces coarse and loose head, reduces keeping quality and enhances the nitrate nitrogen content of head (Ojetayo et al., 2011). Many studies suggests that that application of higher amount of organic manure along with reduced levels of inorganic nitrogen fertilizer can improve the nutritional and keeping quality of cabbage head (Londhe, 2002; Yadav et al., 2001). Productivity of cabbage is highly affected by organic and inorganic nutrients. Due to the residual effect of inorganic fertilizer, organic fetilizers have been preferred over it. Organic fertilizers also increases the productivity of soil as well as crop quality and yield (Tindall, 2000).

Soil plays vital role for production of crops is the main source of plant nutrition. Human beings learnt to grow the crops on soil and further discovered the mineral deposit of other plant nutrients (e.g.P,K,S) and also started applying synthetic fertilizer to increase crop productivity (Eyhorn et al., 2002, Hall and Moffitt 2002). Extensive use of chemical fertilizer and pesticide has caused severe environmental issues like accelerated soil erosion, depletion of soil organic matter, nutrient loss and imbalance and decreased soil organisms (Jordhal & Karlen,1993, Logsdon et al.,1993). Among the various factors of production, the nutrient management has been recognized as the most significant factor limiting the yield levels in various crops (Liu et al., 2010).

Organic manure like FYM, poultry manure biogas slurry etc. are the rich source of organic matter that helps in increasing soil microbial biomass and enzyme activities (EbhinMasto et al., 2006). Organic manure application in soil supplies organic carbon and help to prevent leaching of plant nutrients, helps in soil aggregate formation and improves the physical property of soil. The sole application of farm yard manure (FYM) resulted in increased yield of maize (Anatoliy and Thelen, 2007). Chemical

Quick Response Code	Access this article online	
	Website: www.jcleanwas.com	**DOI:** 10.26480/jcleanwas.01.2020.32.35

Cite the Article: Nabin Dhamala, Keshar Bdr Khatri, Sudip Bhandari, Buddiman Oli, Ramesh Neupane, Rajesh Kumar Yadav, Pradip Pun Magar, Kripa Adhikari, Chiranjibi Puri (2020). Effect Of Integrated Management Of Fym And Urea In Cabbage Grown On Clay Loam Soil, Dang, Nepal. *Journal Clean WAS, 4(1): 32-35.*

fertilizers are the potential sources of high amount of nutrients thus cannot be avoided completely. But overdependence on chemical fertilizer deteriorates soil health and decline crop yields over time (Hepperly et al., 2009).

At the same time application of organic manures alone do not produce required yields due to their low nutrient status. Thus, an integrated use of inorganic fertilizers with organic manures is the best approach to achieve sustainable yield levels (Schoebitz and Vidal, 2016). More nitrogen gets accumulated in soil due to the synergistic effects of organic manures with inorganic fertilizers (Huang et al., 2007). Integrated nutrient management (INM) is the combined use of mineral fertilizers with organic resources such as cattle manures, crop residues, urban/rural wastes, composts, green manures and bio-fertilizers. Main objective of this research is to identify the dose of nutrient which helps to maintain suitable soil property as well as to increase the production of crop.

2. METHODOLOGY

2.1 Site of experiment

The field experiment was conducted at the field of campus of live sciences, Tulsipur dang, Nepal. The geographical location of the farm is in the inner Terai belt at 28°07'24.00"N and 82°17'26.40"E respectively. It is 722m above sea level. The climate of this area is warm and temperate averaging 21.6°C and precipitation is around 1559mm.

2.2 Physio-chemical Property of soil before research

Composite soil samples from 0-30 cm and 30-60 cm depth were taken from each of three blocks prior to the start of field experiment. Composite soil samples were air dried and sieved through 2mm mesh. Soil physio-chemical parameters like pH, organic matter content, available nitrogen, Phosphorous, Potassium, bulk density were determined which are presented in following table 1:

Table 1: Soil physiochemical properties of experimental site

S.N	Parameter	Status
1	Soil texture	Clay loam soil
2	PH	6
3	Soil available nitrogen	0.03%
4	Soil available Phosphorus	110.36kg/hector
5	Soil available potassium	279.26 kg/hector
6	Soil moisture content	20.60%
7	Organic matter	1.05%
8	Bulk density	1.26gm/cm3
9	Particle density	2.1gm/cm3
10	Porosity	40%

2.3 Experiment design

Experiment was laid out in simple RCBD with three replication and six treatments constituting 18 plots. The size of individual plot was 2m×1.6m ($3.2m^2$). Alley of 0.5m length separate two individual plots and 0.5m width separate two individual replication. The size of block was 14.5m × 1.6m ($23.2m^2$). The area under experimental plot was 14.5m × 5.8m ($84.1m^2$). The net cultivated area was $57.6m^2$.

2.4 Treatment

SN	Treatment	Dose
1	T1	Control
2	T2	100 %FYM
3	T3	100% Recommended dose
4	T4	50%FYM+50%RDF
5	T5	25%FYM+75%RDF
6	T6	75%FYM+25%RDF

The purpose of grouping experimental units is to have the units in a block as uniform as possible so that the observed differences between treatments will be largely due to 'true' differences between treatment. Each treatment has the same probability of being assigned to a given experimental unit within a replicate.

2.5 Agronomical operation

Nursery bed of dimension 1m*1m was prepared with the help of spade. The nursery bed will be sterilized by burning trashes three days prior to seeds sowing to control damping off disease of seedlings. Line sowing of seeds of Golden Acre variety of cabbage was done. Line to line spacing was maintained 20 cm and seeds were continuously sown along the line at the depth of 4-5cm. Later, thinning was done to facilitate robust seedling growth. The seedlings were ready for transplanting within a month.

The main field was first ploughed with disc harrow. The weeds and other unwanted materials were removed manually from the experiment plots. Farm yard manure was incorporated in field before fifteen days of transplanting by manual digging with spade during land preparation and final field digging and levelling was done before seedling transplanting. Recommended dose of urea 12kg N\hac was incorporated in soil at the time of transplanting. A full dose of P and K and half dose of N were applied as basal dose. The remaining 1/2 of N was applied at 25DAS and 47DAS during intercultural operation.

First irrigation was applied at the time of sowing. Then crop was irrigated in seven days intervals. Weeding was done at 25, 50, 75 and 90 DAS. The remaining dose of chemical fertilizer was also applied in second and third weeding. Harvesting was done between 110-115 DAT. Six plants/plots were tagged and plant height, stem diameter, head diameter, fresh weight of head, days to maturity, harvesting index and Yield data was collected. The observation were recorded at 30, 60, 110DAT and at harvest.

2.6 Soil test

Soil test was performed before and after the research. Ph, Particle density, Porosity, Organic matter, Bulk density, Soil Nitrogen, Phosphorus and Potassium and soil moisture were calculated.

2.7 Data Analysis

The recorded data were subjected for the analysis of variance and mean separation test was done using Duncan's multiple range tests (Gomez and Gomez, 1984). Data analysis was done using Microsoft excel and R 3.5.3 and agricolae version 1.3-0 package.

3. RESULTS AND DISCUSSION

3.1 Effects of FYM and Urea Application on Plant Parameters

3.1.1 Plant Height

Plant height shows no significant result. At 30DAS, the result showed that the highest (18cm) plant height was obtained from 50%FYM+50%Urea. Similarly, at 60DAS and 110 DAS 50%FYM+50%Urea have the highest plant height i.e. 28.28cm and 33.32cm respectively. In all growth stage, the shortest plant height was obtained from control treatment. Similar findings in the plant height of cabbage were obtained by various researchers and the application of mixed fertilizers influenced the plant height. Sarker et al. (2003) reported significant increase in plant height from 27.52 cm to 43.16 cm of cabbage as the rates increased from control to combined application of N (150 kg ha-1) with FYM (15 t ha-1). The positive effect of FYM on growth parameters obtained in this study was supported by results of Mohammed (1993), who stated that addition of manure significantly increased plant height than only use of inorganic manure. Moreover, Baloch et al. (2000) reported that increased use of nitrogen (200 kg/ha) and FYM (20 t/ha) increased plant height (47.14 cm).

Table 2: Effect of Integrated management of FYM and Urea on height of cabbage.

	Plant height (cm)		
Treatment	30 DAS	60 DAS	110 DAS
T1(F0N0)	12.44	21.11	29.35
T2(F100)	18	28.28	33.32
T3(N100)	15	25.28	30.83
T4(F50N50)	16.38	27.55	32.6
T5(F25N75)	13.91	25.89	32.47
T6(F75N25)	13.55	24.28	31.82
Grand Mean	14.88	11.92	31.74
Sem±	13.04	9.16	10.37
LSD	5.37	5.50	5.85
FTEST	NS	NS	NS
CV %	19.27	11.92	10.45

Means followed by the same letter (ns) in a column are not significantly different at 5% level of significance as determined by DMRT

3.1.2 Number of Leaves Per Plant

At 30 DAS, 50% FYM+ 50% Urea and 100% FYM produced significantly higher leaf number (8 and 7) respectively per plant but were similar with 100% FYM and 25%FYM+75% urea. At 60 and 110 DAS, the leaf number

was not significantly affected by different combination of FYM and Urea higher (9.66 and 15.67) leaf number per plant was obtained at 100%FYM and75%FYM+25%Urea respectively. Sharma found that the integrated application of organic and inorganic fertilizers significantly increased the vegetative growth (Sharma, 2000). A group researcher also observed that combined application of different inorganic and organic fertilizers increased both vegetative and leaf number in cabbage (Khadir et al., 2002).

Table 3: Effect of Integrated management of FYM and Urea on number of leaves of cabbage.

Treatment	30 DAS	60 DAS	110 DAS
	Number of leaves		
Control	5b	9	14.33
100%FYM	7a	9.66	15.67
100%Urea	6.33ab	9.33	14.56
50%FYM+50%UREA	8a	9.33	15.57
25%FYM+75%UREA	6.67ab	9.46	14.67
75%FYM+25%UREA	5.3b	9.66	15.67
Grand Mean	6.39	6.38	15.05
Sem±	0.79	0.78	4.12
LSD(0.05)	1.60	2.38	3.69
F test(<0.05)	*	Ns	Ns
C.V %	13.90	13.91	13.48

Means followed by the same letter (ns) in a column are not significantly different at 5% level of significance as determined by DMRT

3.1.3 Stem Diameter

The effect of various treatments on stem diameter of plant varies significantly (<0.05) at 30, 60 and 110 DAS. At 30 DAS, 50% FYM+ 50% Urea produced significantly higher stem diameter (0.54cm) which was similar with 25%FYM+75%. At 60 and 110 DAS, highest stem diameter (1.10cm and 1.77cm) was obtain at 50% FYM+ 50% Urea and 25%FYM+75% urea respectively. Lowest steam diameter was obtained at control treatment.

Table 4: Effects of Integrated management of FYM and Urea on stem diameter of cabbage.

Treatment	30 DAS	60 DAS	110 DAS
	Stem diameter		
Control	0.38	0.63c	1.09b
100%FYM	0.52	0.98a	1.75a
100%UREA	0.48	0.92ab	1.69a
50%FYM+505UREA	0.54	1.01a	1.77a
25%FYM+75%UREA	0.51	0.91abc	1.53ab
75%UREA+25%FYM	0.44	0.69bc	1.38ab
Grand Mean	0.48	0.85	1.54
Sem±	0.06	0.021	0.054
LSD(0.05)	0.1	0.2	0.3
F test(<0.05)	ns	*	*
C.V %	15.83	16.81	15.08

Means followed by the same letter (ns) in a column are not significantly different at 5% level of significance as determined by DMRT

3.1.4 Biological Yield, Economic Yield and harvesting index

Cabbage yield were highly responsive to various combinations of fertilizers FYM and Urea. Application of Urea and FYM at different rate showed a very highly significant (P<0.05). The highest yield (6.16Mt/hector) per plot was recorded in 50%FYM+50%Urea. While the lowest yield per plant was recorded in control treatment with the value of 1.75Mt/hector. Biological yield of cabbage increased significantly with the application of FYM and Urea. The highest yield (9.63Mt/hector) per plot was obtained by the application of T4 50%FYM+50%Urea which is follow by 25%FYM+75Urea.). A group researcher also observed that combined application of different inorganic and organic fertilizers increased biological yield in cabbage (Khadir et al., 2002). Highest Harvest index was found in treatment 100% FYM (64.95%).

Table 5: Effects of Integrated management of FYM and Urea on total and economic yield and harvesting yield.

Treatment	Economic yield	Total Yield	Harvest index (HI)
CONTROL	1.75d	3.185c	54.94
100%FYM	4.37a	6.728b	64.95
100% Urea	3.63bc	6.866b	52.91
50%FYM+50%UREA	6.16a	9.633a	63.96
25%FYM+75%UREA	4.63b	7.046b	65.76
75%UREA+25%FYM	2.54bc	5.150bc	49.32
Grand Mean	3.83	6.435	
Sem±	4.84	1415277	
LSD(0.05)	1.26	2.17	
Ftest (<0.05	***	**	
C.V %	18.18	18.49	

Means followed by the same letter (ns) in a column are not significantly different at 5% level of significance as determined by DMRT

3.2 Effects of Fym and Urea Application on Soil Parameter

Various parameter of soil was observed and detailed is presented in table below. After application of fertilizer both chemical and organic fertilizers there is slightly increase in ph value of soil. Highest rise was found in treatment 75%FYM+ 25% urea (6.4) compared to other treatment. The pH increased significantly by increasing manure and compost application rate, reflecting its buffering effect on soil (Wong et al., 1999). This is also supported by (Ondrášek and Čunderlík, 2008).

In case of as Nitrogen, Phosphorus and potassium content was increased after the application of fertilizers. However, Fertilizers Nitrogen application show significant result and Phosporus and potassium doesn't show any significant result. Soil nitrogen was recorded highest (0.07%) in 100% FYM application. The favourable soil conditions under FYM addition might have helped in the mineralization of soil N leading to build up of higher available N. Similar results was obtained by (Badanur et al., 1990). Soil phosphorous was recorded highest (297.2kg/hc) in recommended dose urea application. Soil potassium was recorded highest (528kg/hector) in 100%FYM application. The beneficial effect of integrated management on available potassium may be ascribed due to the reduction of potassium fixation and release of potassium with clay, besides the direct potassium addition to the potassium pool of soil (Tandon, 1987).

Highest OM was found in FYM treatment. In our investigation, the addition of FYM increased the total organic matter, macro and micronutrients according to the rate of compost application (Bulluck and Ristaino, 2002). Highest soil moisture was found in treatment recommended dose of FYM (40.46%).Highest Bulk density was found in treatment recommended dose of urea and 25%FYM+75% urea (1.25gm/cm^3).But in case of Particle density found in Control treatment(2.47gm/$cm^{3)}$ and porosity was found maximum in recommended dose of FYM application is (52.19%)respectively. Decrease in bulk density, increase in porosity due to application of FYM was due to increase in organic matter contain which was supported by who reported that soil organic matter helps in nutrient cycling, maintaining soil porosity, bulk density and hydraulic conductivity (Fisher and Blinkley, 2000). The result is also supported by (Wells et al., 2000). Increase in OM decrease BD maximum and increase porosity.

Table 6: Effects of Integrated management of FYM and Urea on Soil parameters

Treatment	**pH**	**%N**	**P_2O_5(kg/ha)**	**K_2O(kg/ha)**	**OM%**	**SMC(%)**	**BD(g/cm^3)**	**PD(g/cm^3)**	**Porosity(%)**
Control	6.23 bc	0.04b	140.8	481.6	1.17bc	23.62b	1.25b	2.47	45.21b
Recommended dose(FYM)	6.33 ab	0.07a	123.7	528	1.46a	40.46a	1.12a	2.33	52.19a
Recommended dose(Urea)	6.13 c	0.05b	297.2	342.2	1.08c	22.8b	1.25b	2.42	44.19b
50%FYM+50%Urea	6.23 bc	0.06ab	170	481.9	1.22b	27.76ab	1.19ab	2.20	45.76b
25%FYM+75%Urea	6.37ab	0.05ab	113.4	364.9	1.23b	29.51ab	1.25ab	2.34	45.91b
75%FYM+25%Urea	6.40 a	0.06ab	137.4	521.4	1.26b	34.79ab	1.18ab	2.15	46.42b
Grand Mean	6.28	0.06	164	453	1.23	29.8	1.21	2.32	46.66
SEM(±)	0.05	0.006	41.7	62.6	0.04	3.34	0.04	0.08	1.32
LSD	0.15	0.02	131.3	197.3	0.13	10.52	0.11	0.25	4.19
Ftest (P>0.05)	*	*	NS	NS	*	*	*	NS	*
CV(%)	1.3	20.5	44.1	23.9	5.5	19.4	5.2	6	4.9

4. Conclusion

Application of FYM and Urea showed a considerable improvement in the growth parameters of cabbage. The tallest plant height (16.38 cm, 28.28 cm and 33.32cm) was produced from 50%FYM+50%Urea, 100%FYM and 100% FYM application when measured at 30, 60 and 110days after transplantation. 50%FYM+50%Urea produced more number of leaves (8) at 30 DAS, where as 75%FYM+25%Urea produced more number of leaves(9.66 and 15.67) at other stages of crop. The highest stem diameter (0.54cm, 1.01cm and 1.77 cm) was obtained from 50%FYM+50%Urea application at 30, 60 and 110 DAS, where as highest head diameter (14.31cm) was obtained from 50%FYM+50%Urea application at 110 DAS. The highest biological yield (9.63mt/hector) was obtained from 50%FYM+50%Urea application at all stages of plant growth. The economic yield (6.16mt/hector) was produced from the application of 50%FYM+50%Urea at different growth stages of plant.

The highest soil moisture (40.46 %) and soil pH (6.40) was obtained from 100%FYM application while recommended fertilizer significantly decreased soil moisture content and soil ph. The lowest bulk density (1.19 gm/cm^3) and highest soil porosity (52.19%) was obtained from 100%FYM application. Application of organic manures significantly affected the soil Nitrogen, Phosphorous, Potassium, soil organic matter. The highest soil Nitrogen (0.07%) was recorded from the 100%FYM application. Although lowest porosity, SOM, highest bulk density was obtained from control plot and RDF plot respectively. Among the various treatment 50%FYM+50%Urea was the best source of organic manure resulting higher head yield of cabbage by improving soil moister content, soil pH, bulk density, soil porosity. Hence, 50%FYM+50%Urea application was recommended in clay loam soil to reduce nutrient risk by improving soil properties.

Acknowledgment

Foremost, we would like to express our sincere gratitude to the soil scientist of Nepal Agriculture Research Council (NARC), khajura, banke member for his inspiring guidance, constant supervision and encouragement during research period. Our completion of research could not have been accomplished without the support of our college chief Dr. shadoe sah for his motivation, enthusiasm and immense Knowledge.

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