Evaluation of different organic manure on nutrient content, uptake and yield of mustard *(Brassica juncea L)* crop.

Abstract

A field experiment was conducted during 2020-21 at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during *Rabi* season to evaluate the "effect of different organic manure on nutrient content, uptake and yield of mustard *(Brassica juncea L)* crop.". The experiment was laid out in randomized block design with Eight treatments and three replications.Eight treatments viz. Control, 100% VC (8 tonnes per hectare), 100% FYM (10tonnes per hectare),100% PM (10 tonnes per hectare),50% FYM + 50% VC + Naturalliquid manure (Jeevamrit), 50% FYM + 50% PM + Natural liquid manure(Jeevamrit), 50% FYM + 25% VC + 25% PM, 25% FYM + 50% VC + 25% PMalong with different management practices were implemented.

The result revealed thatthe highest nutrient content (%) by seed (3.15 N, 0.511 P, 0.560 K) and Stover (0.601 N, 0.180 P, 1.48 K) and the highestnutrient uptake (kg ha^{-1}) of all the three nutrients by seed (56.54 N, 9.17 P, 10.05 K) and stover (28.80 N, 8.63P, 70.92K) were recorded with combined effect of FYM, VC with application of Jeevamrit viz., and 50% NPKS through FYM+ 50% N through VC which was statistically at par toT6. Reduction in nutrient supply resulted significantly lower uptake of N, P and K in the treatment which received only 100% FYM. Similarly, the maximum seed (17.95 q ha^{-1}) and Stover (47.92 q ha^{-1}) yield of mustard was recorded in the T5 treatment (50% FYM + 50% VC + Natural liquid manure Jeevamrit) treatment received 50% recommended doses of NPKS through FYM and 50% N through VC which was at par to T6 in which 50% FYM + 50% PM + Natural liquid manure (Jeevamrit) was applied. However, the lowest value found in control treatment (T6).

Keyword: Organic manure, Jeevamrit, Natural Liquid manure

Introduction

Mustard (Brassica juncea L.) is also known as rai, raya, laha and raiya, whereas, rapeseed is called sarson, toria and yellow toria. The green tender Part of the plant is used for preparing "Sarson Ka Saag. The mustard oil is used for human consumption throughout Northern India in cooking. The oil content in mustard seeds ranges from 37-49 % **(Bhowmik et al., 2014).**

Total area, production and yield of rapeseed-mustard in world during 2018-19 was 36.59 million hectares (mha), 72.37 million tonnes (mt) and 1980 kg/ha, respectively.There has been a considerable increase in production and productivity from 2013-14 to 2018-19. However, there was slight decrease in production and productivity from 2017-18 onward. The rapeseed-mustard acreage increased from 5.98 m ha (2017-18) to 6.12 mha (2018-19) and production got increased from 8.43 mt (2017-18) to 9.26 mt (2018-19). Globally, India continues to be at rank 4th after Canada, China and European Union in acreage (17.19%) and after European Union, Canada and China in production (8.54%). In India Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, West Bengal, and Assam

states accounted for 86.29% of area and 88.46% of production in the country. Rajasthan alone contributed 40.74% to the total area (Fig.1) and 44.97% to the production **(DRMR, 2020).**

In Indian mustard nutrient management is among the most important agronomic factors that affects the growth and yield of crop, but application of all the needed fertilizer through chemical fertilizers had hazardous effect of soil fertility & unsustainable yields. Chemical fertilizers are important input in order to get higher crop productivity, but total dependency on chemical fertilizers are associated with declines in some soil properties and crop yields over time and causes some serious land problems, like soil degradation (Hepperly et al., 2009). Therefore, integration of organic manures and bio–fertilizers would be able to maintain soil fertility and sustain crop productivity efficiently. The addition of organic materials such as crop residues, animal manures, green manures to soils have a direct effect on soil organic matter content and can improve soil fertility, soil physical characteristics, and can augment microbial activities, ameliorate metal toxicity, and by complication. **(Escobar & Wong et al. 2008)**

Soil organic matter upon mineralization releases substantial quantities of Nitrogen, Phosphorus, Sulphur and smaller amount of micronutrients (Rahman et al. 2013). Animal manure is considered to be a valuable nutrient source when applied to soil at rates commensurate with good agronomic practices **(Duffera et al. 1999)**Organic manures like FYM, Vermicompost and Poultry manure are excellent source of nutrients required by plants for quality produce. It contains stable organic matter of up to 60%. Combined application of FYM, Vermicompost produces higher yield along with improving soil health **(Babalad et al.2009).**

Vermicompost helps in improving plant health & acts preventively against fungal diseases. Scientific research conducted on the effects of Vermicompost has found 30-50% increase in nitrogen uptake, increase in root length, root numbers and shoot length. Organic manures enhance the activity of soil, improve the physical and nutritional system of soil and also enhance the activity of soil micro flora**(Hadiyal et al. 2017).** Poultry manure contains nutrient element that can support crop production and enhance the physical & chemical properties of soil and improves lateral water movement. It contains high amount of Nitrogen and Phosphorous than other bulky organic manures and is a good source of production of elements rich fertilizer.

Material and Methods

The field experiment was conducted during Rabi season 2020-2021 at Students Instructional Farm of A.N.D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) situated on Ayodhya-Raibarelly Road about 42 km. away from Ayodhya Head quarter at 26˚47′ N

latitude and 82˚12′ E longitude and at an attitude of about 113 meter above the mean sea level. The field was well levelled having assured irrigation and drainage facilities. The soil was partially reclaimed sodic soil with silt loam texture, slightly alkaline in reaction (pH 8.10) with low in organic carbon (0.51%), low available nitrogen (154.00 kg ha^{-1}), medium in available phosphorus (20.40 kg ha^{-1}), available potassium (218 kg ha^{-1}) and available Sulphur (8.78 kg ha^{-1}).The experiment was comprised of eight treatments *viz.*Control, 100% VC (8 tonnes per hectare), 100% FYM (10tonnes per hectare),100% PM (10 tonnes per hectare),50% FYM + 50% VC + Naturalliquid manure (Jeevamrit), 50% FYM + 50% PM + Natural liquid manure(Jeevamrit), 50% FYM + 25% VC + 25% PM, 25% FYM + 50% VC + 25% PMalong with different management practices were implemented.All the treatments were randomly allocated and replicated three times in a randomized block design. The mustard variety Varunawas grown and growth & yield, nutrient uptake, soil properties as influenced by different treatments were assessed.

Plant samples (Stover and seed) were collected randomly from each experimental unit at the time of harvest for the evaluation of nutrient content and uptake. The samples were dried in oven at 60 0C for 8 hrs. Oven dried plant samples (Stover and seed) were ground in stainless steel grinder for analysis of nitrogen, phosphorus and potassium. The processed Stover and seed samples were digested with conc. H2SO4 and H2O2 in presence of catalyst mixture. Modified Kjeldahl's method was adopted for determination of nitrogen content in stover and seed as described by Jackson (1973). The percentage of nitrogen content was multiplied with grain and straw yield to obtain nitrogen uptake by seed and straw, respectively.

The ground seed and Stover samples were digested with ternary acid mixture, having nitric, perchloric and sulphuric acid in 10:4:1 ratio and was determined byvanadomolybdo phosphoric yellow colour method (Jackson, 1973). The percentage of phosphorus content was multiplied with seed and Stover yield to obtain phosphorus uptake by seed and Stover, respectively. Potassium content in digested seed and Stover samples with ternary acid were determined separately by using flame photometer (Jackson, 1973). The percentage of 30 potassium content was multiplied with seed and Stover yield to obtain potassium uptake by seed and Stover, respectively.After harvesting, the yield per plot were recorded in kg separately and converted into t ha^{-1}.

Results and Discussion

Comment [S1]: What's control? Farming practices?or the vulgarized formula?

Comment [S2]: Give the characteristics of the Varuna mustard variety because yields are low in my opinion.

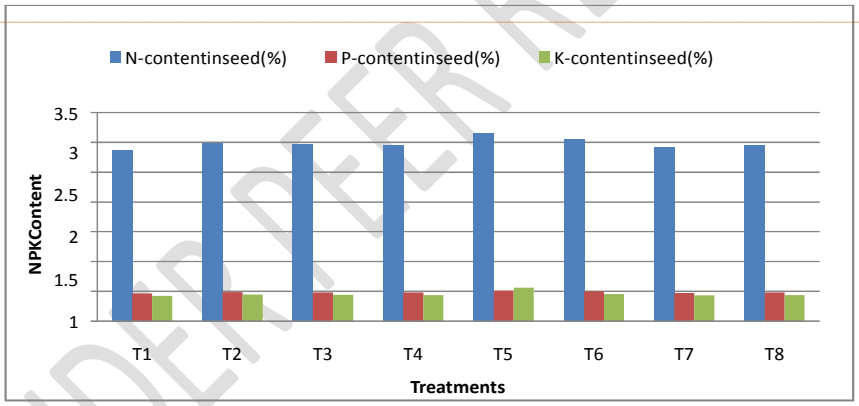
Comment [S3]: The results are not widely discussed

Nutrient content and uptake by seed: The data regarding to the N, P&K content (%) and uptake (kg ha^{-1}) in seed of mustard weretabulatedandanalyzedstatisticallyandtheresultshavebeenpresentedinresulttable. It is realistic from the result Table 1, the application of various organicmanure significantly influence the N-content (%) in mustard seeds and with thesubmission of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 foundsignificantly highest N-content (%) in mustard seeds followed by 50% FYM + 50%PM+Naturalliquidmanure(Jeevamrit)T6over100%VC(8tonnesperhectare)T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+ 25%VC +25%PM,25%FYM+50%VC+25%PM T8andovercontrol in that order. The untreated plot (control plot) plot with organic manure createdsignificantlylowestN-content(%)inseedofmustard. It is practical from the results Table 1, the application of various organicmanuresignificantlyinfluencetheP-content(%)inmustardseedsandwiththegivinginof50%FYM+50%VC+Naturalliquidmanure(Jeevamrit)T5foundsignificantly highest P-content (%) inmustard seeds followed by 50% FYM + 50%PM+Naturalliquidmanure(Jeevamrit)T6over100%VC(8tonnesperhectare)T2,100%FYM(10tonnesperhectare)T3,100%PM(10tonnesperhectare)T4,50% FYM+25%VC +25%PM,25%FYM +50% VC+ 25%PM T8and over control inthatorder.Theuntreatedplot(controlplot)plotwithorganicmanurecreatedsignificantlylowestp-content(%)inseedofmustard. It is realistic from the results Table 1, the application of various organicmanure significantly influencetheK-content (%) in mustard seeds and withthe givinginof50%FYM+50%VC+Naturalliquidmanure(Jeevamrit)T5foundsignificantly highest K-content (%) in mustard seeds followed by 50% FYM + 50%PM+Naturalliquidmanure(Jeevamrit)T6over100%VC(8tonnesperhectare)T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+25%VC +25%PM,25%FYM+50% VC+ 25%PMT8 andovercontrol in that order. The untreated plot (control plot) plot with organic manure createdsignificantlylowestK-content(%)inseedofmustard. TheN,P,Kcontentinseedofmustardsignificantlyincreasedwithplottreatedwith T5 treatment (50% FYM + 50% VC + Natural liquid manure (Jeevamrit) overrest treatments. T5 treatment increased 8.89% over untreated plot (cf table3). TheN, P, K increased 8.89%, 8.81% and 24.11% respectively. It is certified that theorganic manure increased the availability of N.P.K to mustard plant so that the NPKcontentincreasedin seed. The same findings also reported by **Chung *et al* (2000), Laxminarayana and Patiram (2006), Singh *et al* (2009), Kumar *et al* (2008), Datta *etal*(2011)andSingh*etal*(2011).**

Table 1- Effectofdifferentorganicmanureon N.P.K.content(%) and uptake (kg/ha)by seed ofmustard

Treatments	N-contentinseed (%)	P-contentinseed (%)	K-contentinseed (%)	N- uptakebySeed(kg/ha)	P-uptakebyseed(kg/ha)	K-uptakebyseed(kg/ha)	Seed Yield (q/ha)
T1	2.87	0.466	0.425	38.89	6.31	5.76	13.55
T2	2.99	0.485	0.443	48.68	7.89	7.21	16.28
T3	2.97	0.482	0.440	43.56	7.06	6.45	15.40
T4	2.95	0.479	0.437	44.55	7.23	6.60	15.10
T5	3.15	0.511	0.560	56.54	9.17	10.05	17.95
T6	3.05	0.495	0.452	52.92	8.59	7.84	17.35
T7	2.91	0.472	0.431	45.74	7.42	6.78	14.97
T8	2.95	0.479	0.437	44.69	7.26	6.62	15.15
SE(m)	0.05	0.007	0.005	1.51	0.43	0.36	0.67
CD(p=0.05)	0.14	0.019	0.012	4.58	1.30	1.09	2.04

Fig1.EffectofdifferentorganicmanureonNPKcontentinseedofmustard.



The data regarding to the N, P&K uptake (kg ha^{-1}) by seed of mustard weretabulatedandanalyzedstatisticallyandtheresultshavebeenpresentedinresulttable. It is realistic from the result Table 1, the purpose of various organic manuresignificantly influence the N-uptake by seed of mustard and with the submission of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest N-uptake bymustard seeds followed by 50% FYM + 50% PM + Naturalliquid manure (Jeevamrit) T6 over 100% VC (8 tonnes per hectare) T2, 100% FYM(10 tonnes per hectare) T3, 100% PM (10 tonnes per hectare) T4, 50% FYM + 25%VC + 25% PM, 25% FYM+ 50% VC + 25% PM T8 and over control in that

Comment [S4]: Figure legends must be indicated below the figures.

Comment [S5]: Looking at this figure, I can't see any significant differences between treatments.

Formatted: Font: (Default) Times New Roman, Superscript

order.Theuntreatedplot(controlplot)plotwithorganicmanurecreatedsignificantlylowestN-uptakebyseedofmustard.

ItispracticalfromtheresultsTable1,therequestofvariousorganicmanuresignificantlyinfluencetheP-uptake(kg/ha)bymustardseedsandwiththegenerousinof 50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest P-content (%) in mustard seeds followed by 50% FYM + 50% PM + Naturalliquid manure (Jeevamrit) T6 over 100% VC (8 tonnes per hectare) T2, 100% FYM(10 tonnes per hectare) T3, 100% PM (10 tonnes per hectare) T4, 50% FYM + 25%VC+25%PM,25%FYM+50%VC+25%PMT8andovercontrolinwiththeaimoforder.Theuntreatedplot(controlplot)plotwithorganicmanurecreatedsignificantlylowestp-uptake(kg./ha^{-1})byseedofmustard.

ItisreasonablefromtheresultsTable1,theclaimofvariousorganicmanuresignificantly pressure the K-uptake (kg./ha^{-1}) by mustard seeds and with the charitableinof50%FYM+50%VC+Naturalliquidmanure(Jeevamrit)T5foundsignificantlyhighestK-uptakebymustardseedsfollowedby50%FYM+50%PM+Natural liquid manure (Jeevamrit) T6 over100% VC (8 tonnes per hectare) T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+ 25%VC +25%PM,25%FYM+50%VC+25%PM T8andovercontrol in that order. The untreated plot (control plot) plot with organic manure twistedsignificantlylowestK-uptakebyseedofmustard**.** The N,P,K uptake kg/ha by the seed of mustard significantly noted highestwith application of T5 treatment (50% FYM + 50% VC + Natural liquid manure(Jeevamrit)andtheNitrogenuptake31.22%,Phosphorus31.19%andPotash42.68%over control correspondingly. It is attributed due to the N.P.K content and yield ofseedofmustardfoundhigherthesaidtreatment.

Thesameconclusionalsoreportby**Chunge*tal*(2000),Laxminarayana and Patiram (2006), Singh *et al* (2009), Kumar *et al* (2008), Datta *etal*(2011)andSingh*etal*(2011)**

Nutrient content and uptake by stover:

The data regarding to the N.P. and K. content (%) and uptake (kg./ha^{-1}) in Stover of mustard weretabulatedandanalyzedstatisticallyandtheresultshavebeenpresentedinresulttable. ItisapparentfromtheresultTable2,thereasonofvariousorganicmanuresignificantly pressure the N-content (%) in Stover of mustard and with the giving in of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest N-content (%) in Stover ofmustard followed by 50% FYM + 50% PM +Natural liquid manure (Jeevamrit) T6 over100% VC (8 tonnes per hectare) T2,100%FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+25%VC+25%PM,25%FYM+50%VC+25%PMT8andovercontrol inthatorder.Theuntreatedplot(controlplot)withorganicmanurecreatedsignificantlylowestN-

Formatted: Font: (Default) Times New Roman, Superscript

Formatted: Font: (Default) Times New Roman, Superscript

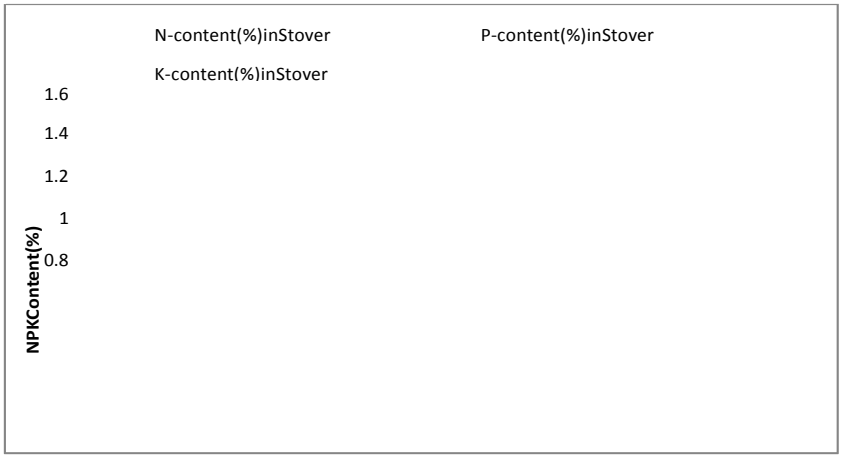
content(%)Stoverofmustard. It is matter-of-fact from the results Table 2, the request of various organicmanure significantly weight the P-content (%) in Stover of mustard and with thegiving of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 foundsignificantly highest P-content (%) in mustard Stover followed by 50% FYM + 50%PM+Naturalliquidmanure(Jeevamrit)T6over100%VC(8tonnesperhectare)T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+ 25%VC +25%PM,25%FYM+50%VC+25%PM T8andovercontrol in with the aim of order. The untreated plot (control plot) plot with organic manurecreatedsignificantlylowestp-content(%)inStoverofmustard. It is obvious from the results Table 2, the aver of various organic manuresignificantly pressure the K-content (%) in Stover of mustard and with the giving in of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest K-content in Stover of mustard followed by 50% FYM + 50% PM + Naturalliquid manure (Jeevamrit) T6 over 100% VC (8 tonnes per hectare) T2, 100% FYM(10 tonnes per hectare) T3, 100% PM (10 tonnes per hectare) T4, 50% FYM + 25%VC + 25% PM, 25% FYM+ 50% VC + 25% PM T8 and over control in that order.Theuntreatedplot(controlplot)withorganicmanuretwistedsignificantlylowestK-contentinStoverofmustard.

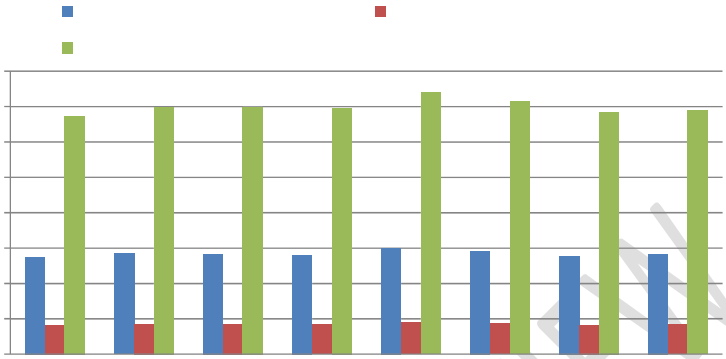
Table 2- EffectofdifferentorganicmanureonN.P.K.content(%) and uptake (kg/ha)ofmustardStover

Treatments	N-content(%)in Stover	P-content(%)in Stover	K-content(%)in Stover	N-uptake(kg/ha) byStover	P-uptake(kg/ha)by Stover	K-uptake(kg/ha)by Stover	Stover Yield (q/ha)
T1	0.548	0.164	1.35	20.80	6.22	51.23	37.95
T2	0.570	0.171	1.40	25.80	7.74	63.38	26.45
T3	0.567	0.170	1.40	24.36	7.30	60.14	42.96
T4	0.563	0.169	1.39	23.76	7.13	58.67	42.21
T5	0.601	0.180	1.48	28.80	8.63	70.92	47.92
T6	0.582	0.174	1.43	27.27	8.15	67.01	46.86
T7	0.555	0.166	1.37	24.44	6.97	57.53	41.99
T8	0.568	0.169	1.38	23.78	7.14	56.29	42.24
SE(m)	0.008	0.002	0.02	0.82	0.36	2.21	1.43
CD(p=0.05)	0.025	0.006	0.06	2.48	1.10	6.63	4.33

Fig.2ofdifferentorganicmanureonNPKcontent(%)inStoverofmustard

Comment [S6]: Figure legends must be indicated below the figures.





ThedataregardingtotheN,P,&KuptakebyStoverofmustardweretabulatedandanalyzedstatistical lyandtheresultshavebeenpresentedinresulttable. It is plain from the result Table 2, the basis of various organic manuresignificantlyforcetheN-uptake(kg/ha)byStoverofmustardandwiththeopenhanded in of50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5found significantly highest N-uptake (kg/ha) by Stover of mustard followed by 50%FYM + 50% PM + Natural liquid manure (Jeevamrit) T6 over100% VC (8 tonnesper hectare) T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes perhectare)T4,50%FYM+25%VC+25%PM,25%FYM+50%VC+25%PMT8 and over control in that order. The untreated plot (control plot) with organic manurecreatedsignificantlylowestN-uptakebyStoverofmustard. It is matter-of-fact from the results Table 2, the request of various organicmanuresignificantlyweightttheP-uptakebyStoverofmustardandwiththegivingof50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest P-uptake (kg/ha) bymustard Stover followed by 50% FYM + 50% PM +Natural liquid manure (Jeevamrit) T6 over100% VC (8 tonnes per hectare) T2,100% FYM (10 tonnes per hectare) T3,100% PM (10 tonnes per hectare) T4, 50%FYM+25%VC+25%PM,25%FYM+50%VC+25%PMT8andovercontrol inwiththeaimoforder.Theuntreatedplot(controlplot)withorganicmanurecreatedsignificantlylowestp-uptakebyStoverof mustard. It is apparent from the results Table 2, the aver of various organic manuresignificantly force the K-uptake (kg/ha) by Stover of mustard and with the giving inof 50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantlyhighest K-uptake (kg/ha) by Stover of mustard followed by 50% FYM + 50% PM +Natural liquid manure (Jeevamrit) T6 over100% VC (8 tonnes per hectare) T2,100% FYM (10 tonnes per hectare) T3,100% PM (10

tonnes per hectare) T4, 50%FYM+25%VC+25%PM,25%FYM+50% VC+ 25%PM T8and overcontrol

inthatorder.Theuntreatedplot(controlplot)withorganicmanureabnormalsignificantlylowestK-uptake(kg/ha)byStoverofmustard.

Thesamefindingsalsoreportedby**Rameshetal(2009),Chungetal(2000),Singhetal(2009)Dattaetal(2011),Rathod *et al* (2003), Kaushik *et al* (1984), Bellakki and Badanur (1997), Singh *et al*(1982).**

It is reasonable from the result Table 1, the application of various organic manure significantly influence the seed yield (q/ha) of mustards of mustard crop and with the submission of 50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 found significantly highest seed yield (q/ha) of mustard followed by 50% FYM + 50% PM + Natural liquid manure (Jeevamrit) T6 over 100% VC (8 tonnes per hectare) T2, 100% FYM (10 tonnes per hectare) T3, 100% PM (10 tonnes per hectare) T4, 50% FYM + 25% VC + 25% PM, 25% FYM + 50% VC + 25% PM T8 and over control in that order. The untreated plot (control plot) plot with organic manure created significantly lowest seed yield (q/ha) of mustard crop. It is clear from the result Table 2, the application of various organic manure significantly force the Stover yield (q/ha) of mustard crop and with the agreement of 50% FYM + 50% VC + Natural liquid manure (Jeevamrit) T5 establish significantly advanced of mustard followed by 50% FYM + 50% PM + Natural liquid manure (Jeevamrit) T6 over 100% VC (8 tonnes per hectare) T2, 100% FYM (10 tonnes per hectare) T3, 100% PM (10 tonnes per hectare) T4, 50% FYM + 25% VC + 25% PM, 25% FYM + 50% VC + 25% PM T8 and over control in that order. The untreated (control plot) plot with organic manure originates significantly lowest Stover yield (q/ha) of mustard crop. The same findings also reported by **Laxminarayana et al (2006), Arya et al (2007), Nagdive et al (2007), Dongarwae et al (2007), Nanwal et al (2007).**

Comment [S7]: The results are not widely discussed

Conclusion

On the basis of one year field experiment made during rabi 2020-2021, it may be concluded thatthe N.P. and K content along with uptake (kg./ha^{-1}) in seed and Stover were recorded more in the T5. The grain yieldand Stover yield recorded highest in the application of T5(50% FYM + 50% VC + Natural liquid manure Jeevamrit) treatment received 50% recommended doses of NPKS through FYM and 50% N through VC.

References-

Arya, R.L., Varshney, J. G. and Kumar L.(2007). Effect of integrated nutrient application in chickpea + mustard intercropping system in the semi-arid topics of North India. *Communications in Soil Science and Plant Analysis*, 38(1/2): 229-240.

Babalad, H. B., Poojar, S., and Vidyavathi, G. Y., and (2022). Influence of ghanajeevamrutha and liquid organic manures on soil fertility and productivity of chickpea in vertisol.

Bellakki, M. A.; Badanur, V. P. and Setty, R. A. (1997).Long-term effect of integrated nutrient management on properties of vertisol under dryland agriculture. *J. Indian Soc. Soil Sci*. 45: 438-442.

Bhowmik, B., Mitra, B. and Bhadra, K. (2014). Diversity of insect pollinators and their effect on the crop yield of *Brassica junceaL*., NPJ-93, from Southern West Bengal.*International Journal of Recent Scientist Research*, **5**(6): 1207-1213.

Chung, R. S.; Wang, C.H.; Wang, C.W. and Wang, Y. P. (2000). Influence of organic matter and inorganic fertilizer on the growth and nitrogen accumulation of corn plants. *J. Plant Nutr.*, **23** (3): 297-311.

Datta, A. B.; Mondal, J. K. and Chanda, N.K. (2011). Influence of integrated nutrient management on soil properties of old alluvial soil under mustard cropping system. *Communications in Soil Science and Plant Analysis*, **42** (20): 2473-2492.

Dongarwar, U. R.; Bhalerao, P.D. andNegduie, S. J. (2007). Effect of irrigation and INM on growth and yield of Indian mustard. *Annals Physiol.*, **21** (2): 182-185.

Duffera, M. Robarge, W.P., and Mikkelsen, R.L. (1999) Estimating the Availability of Nutrients from Processed SwineLagoon Solids through Incubation Studies. *Bioresource Tech.*, 70, 261-268.

Escobar, M.E.O. and Hue, N.V. (2008) temporal changes of selected chemical properties in three manure amended soils of hawaii. *Bioresource Tech.*, 99, 8649-8654.

Hadiyal, J. G., Kachhadiya, S. P., Ichchhuda, P. K., &Kalsaria, R. N. (2017). Response of Indian mustard (Brassica juncea L.) to different levels of organic manures and bio-fertilizers. *Journal of Pharmacognosy and Phytochemistry*, *6*(4), 873-875.

India. Directorate of Rapeseed-Mustard Research,. 2020, Project Coordinator's Report. Bharatpur, Rajasthan.

Comment [S8]: In fact, there are many old references!

Comment [S9]: Harmonize fonts!

Comment [S10]: Harmonize fonts!

Kaushik, R. D., Verma, K. S.; Dang, Y. P.; Sharma, A. P.; Verma, S. I. and Pannu, B. S. (1984). Effect of nitrogen and farm yard manure on yield of crops, nutrients uptake and soil fertility in paddy wheat rotation. *Indian J. Agril. Res.*, **18**: 73-78.

Kumar, M. and Singh, A. K. (2008). A study on nutrient uptake by paddy in integrated use of fertilizers and vermicompost. *Asian J. Soil Sci.*,**3**(1): 40-41

Laxminarayana, K. and Patiram (2006). Effect of integrated use of inorganic, biological and organic manure on rice productivity and soil fertility in Ultisols of Mizoram. *J. Indian Soc. Soil Sci.*, **45** (20): 213-220.

Nagdive, S. J.; Bhalerao, P. D. and Dongarwar, U. R. (2007). Effect of irrigation and integrated nutrient management on growth and yield of Indian mustard. *Annals of Plant Physiology*, **21**(2): 182-185.

Nanwal, S. and Yadav R. K. (2007). Productivity and quality of Indian mustard (*Brassica juncea*) as influenced by integrated nutrient management treatments in semi-arid environment. *Environment and Ecology*, **25** (4): 956-958.

Ramesh, P.; Panwar, N. P.; Singh, A. B. and Ramana, S. (2009a.). Production potential, nutrient uptake, soil fertility and economics of soybeen (*Glycine max*) based cropping system under organic, chemical and integrated nutrient management practices. *Indian J. Agron.*, **54** (3): 278-283.

Ramesh, P.; Panwar, N. R.; Singh, A. B. and Ramana, S. (2009b.). Effect of organic nutrient management practices on the production potential, nutrient uptake, soil quality, input-use efficiency and economics of mustard (*Brassica juncea*). *Indian J. Agric. Sci.*, **79** (1):40-44.

Rathod, V. E.; Sagare, B. N.; Ravankar, H. N.; Sarazp, P. A. and Hadole, S. S. (2003). Efficiency of amendments for improvement in soil properties and yield of cotton grown in sodic vertisols of Vidarbha Using alkali water. *J. Soils and Crops*, **13** (1): 176-178.

Singh, A. K.; Amgain, L. P. and Singh, S. S. (1998). Integrated nutrient management in rice-wheat system under midland situation. In Extended Summaries of 21st International Congress on Agronomy, held at New Delhi, during November 23rd 1998, pp. 450-451.

Singh, P. K.; ImnuksungbaKanajuia and S. P. (2009). Effect of integrated nutrient management on growth, yield, its attributes and nutrients uptake of mustard crop in acidic soils of Nagaland. *Environment and Ecology*; **27** (3):1036-1039.

Singh, R. P., Pal, Y. and Singh H. (2011). Effect of organic and inorganic sources of nutrients on growth, yield and quality of Indian mustard (*Brassica juncea* L.) under late sown condition. *Pantnagar J. Res.*, **9** (2):308-310.