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Effect of Cropping Module and Row Ratio on Growth and Quality of Chickpea (*Cicer arietinum* L.) + Linseed (*Linium usitatissium* L.) Intercropping

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ABSTRACT: In order to evaluate the effect of Cropping Module and Row Ratio on Growth and Quality of Chickpea (*Cicer arietinum* L.) + Linseed (*Linium usitatissium* L.), the experiment was carried out on well drained sandy clay loam soil, low in organic carbon and available nitrogen, medium in available phosphorus, potassium, sulphur and moderately alkaline in pH, at crop research centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), during 2021-22 the experiment was comprising with 16 treatments consisting combination of 4 intercropping and 4 cropping modules. *viz.*, chickpea sole, linseed sole, chickpea + linseed in ratio of 1:1, chickpea + linseed in ratio of 2:1 and 4 cropping module *viz.*, control with no use of any nutrient management option, inorganic module with recommended dose of fertilizers NPKS, organic module with FYM, *Tricoderma*, seed inoculation by *Rhizobium*, PSB and natural module with seed treatment beejamruith, foliar application of jeewamruith, soil application of panchgavya. Chickpea and linseed variety Avrodhi and Garima was tested in split plot design with 3 replications. Thus, in the intercropping chickpea crop with ratio of 2:1 and linseed crop with ratio of 1:1 found better than the rest of the treatments and cropping module inorganic cropping module found better than rest of the cropping module. Found maximum growth (plant height, dry matter accumulation and number of nodules), protein content and yield, oil content and yield.

Keyword: Chickpea (*Cicer arietinum* L.), Linseed (*Linium usitatissium* L.), Inorganic module, Organic module, Natural module, Intercropping.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) play a crucial role in Indian agriculture and India is the largest producer and consumer of Chickpea within the world. Particularly the daily per capita availability of 14g chickpea could be a source of 56 kcal energy 2.7 g protein to the Indian population, it contain 18-22% protein, Its leaves contain citric and malic acids which are superb for the stomach, It assists in lowering cholesterol in the blood stream. It's utilized in preparing a range of snacks and sweets, Fresh green seeds are consumed as a green vegetable. In the world, it's cultivated on 14.84 M ha area, 15.08 MT productions, and produces a median of 10.16 q ha^{-1} (FAOSTAT, 2020), In India, it's cultivated on 9.63 M ha area, 11.91 MT production, and productivity 10.41 q ha^{-1} (DoA, C&FW 2020-21), Uttar Pradesh holds 4th position in terms of area 0.57 M ha, production 0.53 MT, and average productivity 930 kg ha^{-1} (Agriculture Statistics at a Glance, GoI 2021) after Madhya Pradesh, Rajasthan, and Maharashtra. It has vital role in biological organic matter improving soil productivity and adding a sufficient amount of organic matter in the soil. India has self-sufficiency in food product but still lagging in pulses and oilseed production. Linseed (*Linum usitatissium* L.) is grown for seed and fiber. In India, it's mainly grown for seed to extract oil. It contains 20-24% protein and 37-42% oil. Linen, one of the finest fabrics, has the most recent sensation in elite dressing worldwide and is obtained from the fiber verities of linseed, called flax. It has a novel drying property and is suitable for manufacturing paints, varnishes, ink, etc. a tiny low part is used as edible oil also. In the world, linseed is cultivated on 3.54 M ha area, 3.37 MT production, and a median yield of 9.51 q ha^{-1} (FAOSTAT, 2020). In India linseed is cultivated on 0.298 M ha area, 0.11 MT production, and produced a median of 5.47 q ha^{-1} (DoA, C&FW 2020-21). In Uttar Pradesh, it's cultivated on 0.18 M ha area, 0.12 MT production, and productivity is 671 kg ha^{-1} (Ministry of Agriculture, GoI 2020). In 2014, linseed was approved by Health Canada for a health claim linking the consumption of whole flaxseed

to lowered blood cholesterol levels, a serious risk factor for cardiovascular disease. It's also grown as pair or utera crop in rice fields. Cereal + oilseeds intercropping is that the most ordinarily practiced system of intercropping having crops complementary effects instead of competitive effects. In intercropping, the row arrangement of crops is a crucial aspect to be considered. The correct spacing, of the component crops, is subjected to least by adjusting the rows for most of the crops with the accommodation of intercrop. It ensures penetration of an affordable amount of radiation for the dwarf component of system without much competition for space and nutrients.

MATERIALS AND METHODS

The field experiment was conducted at CRC farm of the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) located in Indo-Gangetic plains of Western Uttar Pradesh. Meerut lies on national highway 58 and is at a distance of 70 km from Delhi. Meerut predominantly enjoys semi-arid and sub-tropical climate with extremely hot summer and cold winter. The crop experienced lowest mean minimum weekly temperature of 4.7 ^{o}C in 3rd week of January and highest mean maximum weekly temperature of 37.5 ^{o}C in 2rd week of April during the crop period. Mean relative humidity noted in 3rd week of January was 92.6 %, however the most dry month was the 2nd week of April 34.3%. Accordingly, the evaporation demand of the atmosphere varied during crop period. The amount of total rainfall received was 67.5 mm in 4 rainy days. The soil of experimental site was sandy clay loam in texture, low in available nitrogen and organic carbon, medium in available phosphorus and potassium and slightly alkaline in reaction. The experiment was carried out with 16 treatments consisting combination of 4 intercropping *viz*., chickpea sole, linseed sole, chickpea + linseed ratio 1:1, chickpea + linseed ratio 2:1 and 4 cropping module *viz*., control, inorganic module with recommended dose of fertilizer, organic module with FYM, *Tricoderma*, seed inoculation by *Rhizobium*, PSB and natural module with seed treatment by beejamruith, jeewamruith by foliar application, panchgavya by soil application, were tested in split plot design with 3 replications. Chickpea was taken as a base crop with plating geometry 30 cm × 15 cm. Prior to 12 hours of sowing, seed were treated *Rhizobium* inculcation in chickpea. The recommended dose of fertilizer for chickpea and linseed are 18:40:20:20 and 120:40:20:20 kg of N, P_2O_5 and S per hectare respectively. Farm yard manure was applied wherever needed as per treatment combinations. *Tricoderma* was applied in field with FYM. Mix the *Tricoderma* fungus with FYM and broadcasted within the treatment plots where ever *Tricoderma* was needed. Panchgavya was given in to 2 doses first was at the time of field preparing and second with irrigation water. Jeewamrutha was given in four doses, 1st dose was given at the time of sowing and then after 21 days interval as a foliar sprays (10%) within the field. Beejamrutha was used as seed treatment of chickpea and linseed. For linseed seed, seed was coat with beejamrutha, mixing by hand, dry well then sown on filed, except for chickpea, seeds just dip quickly and then dry in shade and then sown on field. Economic of the treatments was computed on the premise of prevailing value of input and output under each treatment. Statistical analysis of the data was done as per the standard analysis of variance technique for the experimental designs following SPSS software based programme, and the treatment means were compared at $P< 0.05$ level of probability.

RESULT AND DISCUSSION

Effect of cropping system and row ratio on growth parameters. The data presented in (Table 1) revealed that plant height, dry matter accumulation, number of nodules influenced by different intercropping ratios and cropping modules. Plant height, dry matter accumulation, recorded at various growth stages (30, 60, 90 DAS and at harvest) of chickpea and linseed influenced by intercropping and cropping modules treatment. Growth parameters are increased with advancement of crop age and reached to its maximum at maturity, irrespective of the treatments. It is evident from the data growth parameters that differ significantly with respect to different treatments levels at all the crop growth stages.

Plant height (cm). Plant height was recorded at 30, 60, 90 DAS and at harvest. Chickpea sole recorded the highest plant height (14.20, 29.05, 44.63 and 55.5 cm), which was significantly at par with the both intercropping ratios of 2:1 chickpea + linseed (14.03, 28.58, 44.18 and 55.23 cm) and 1:1 chickpea + linseed (13.35, 28.33, 43.35 and 43.28 cm). Linseed sole recorded the highest plant height (18.05, 48.50, 85.43 and 93.08 cm), which was significantly at par with the ratio of 1:1 chickpea + linseed (15.88, 47.55, 83.18 and 90.26 cm). Between the both the ratio of 2:1 chickpea + linseed found lowest plant height (11.90, 40.66, 71.13 and 79.0 cm). Similar finding was given by Tripathi *et al.* (2005); Kumar and Singh (2006). Wasu *et al.* (2013), Singh and Aulakh (2017). Among the cropping modules the highest plant height was recorded in inorganic cropping module (11.15, 22.45, 33.90 and 42.0 cm) which was significantly at par with the organic (10.80, 22.10, 33.60 and 41.38 cm) and natural module (10.58, 21.83, 33.30 and 41.18 cm). Whereas the lowest plant height was recorded by control (9.05, 19.58, 31.35 and 39.45 cm). In linseed the highest plant height was recorded in inorganic cropping module (12.36, 35.08, 62.93 and 68.28 cm) which was significantly at par with the organic (12.33, 35.08, 62.15 and 68.27 cm) and natural module (12.05, 34.88, 62.05 and 67.98 cm). Whereas the lowest plant height was recorded by control (9.10, 31.76, 52.15 and 58.23 cm). Similar result was given by Siddappa *et al.* (2016); Yadav *et al.* (2017); Anshul (2018); Yadav *et al.* (2019).

Table 1: Effect of cropping system and row ratio on plant height (cm), DMA (g plant^{-1}), No. of Nodules plant^{-1} of chickpea and linseed.

Treatments	Chickpea			Linseed	
	Plant height (cm)	DMA (g plant^{-1})	No. of Nodules plant^{-1}	Plant height (cm)	DMA (g plant^{-1})
Intercropping system					
Sole Chickpea	55.50	32.63	28.65	-	-
Sole Linseed	-	-	-	93.08	25.58
Chickpea + Linseed 1:1	53.28	31.67	21.53	90.26	24.78
Chickpea + Linseed 2:1	55.23	32.00	27.35	79.00	23.85
SEm±	*1.23*	*0.72*	*0.36*	*1.89*	*0.51*
CD (P=0.05)	***4.24***	**NS**	***1.26***	***6.54***	***1.77***
Cropping system modules					
Control	39.45	23.05	21	58.23	17.48
Inorganic module	42.00	24.80	23.48	68.28	19.15
Organic module	41.38	24.33	23.08	68.27	18.88
Natural module	41.18	24.13	22.95	67.98	18.70
SEm±	*0.78*	*0.46*	*0.43*	*1.64*	*0.40*
CD (P=0.05)	***2.29***	***NS***	***1.24***	***4.79***	***NS***

Dry matter accumulation (g plant^{-1}). Dry matter accumulation was recorded at 30, 60, 90 DAS and at harvest. Among the sole and intercropping treatments dry matter was non-significant in respect of chickpea at harvest. Linseed sole recorded the highest dry matter (0.93, 11.68, 22.85 and 25.58 g plant^{-1}), which was significantly at par with the ratio of 1:1 chickpea + linseed (0.70, 11.45, 22.60 and 24.78 g plant^{-1}) and ratio of 2:1 chickpea + linseed (0.58, 11.10, 21.90 and 23.85 g plant^{-1}). Among the cropping module treatments dry matter was non-significant in respect of chickpea and linseed both. Similar result was reported by Arya *et al.* (2007); Gan *et al*. (2009); Chaudhary (2010), Shyamrao *et al.* (2016); Biradar *et al.* (2017)

Number of nodules plant^{-1} in chickpea. Number of nodules was recorded at 30, 45 and 60 DAS. Chickpea sole recorded the highest number of nodule (20.13, 33.85 and 28.65), which was significantly higher than the both intercropping ratios. Among the intercropping ratio of 2:1 chickpea + linseed (19.03, 33.10, and 27.35) recorded significantly higher number of nodule than ratio of 1:1 chickpea + linseed (14.58, 23.55 and 21.53). Among the cropping modules the highest number of nodule was recorded in inorganic cropping module (14.13, 23.48 and 20.18) which was significantly at par with the organic (13.70, 23.08 and 19.73) and natural module (13.43, 22.95 and 19.65). Whereas the lowest number of nodule was recorded by control (12.48, 21 and 17.98). Similar finding was given by Sharma and Goswami (2010); Abraham *et al.* (2011); Wasu *et al*. (2013); Biradar *et al*. (2015); Kalaghatagi *et al*. (2017).

Effect of cropping system and row ratio on quality

Protein content and yield. The data presented in (Table 2 and Fig. 1) revealed that the protein content (%) influenced significantly by the intercropping. The highest protein content (20.25 %) was recorded with sole chickpea which was significantly at par with the chickpea + linseed 1:1 (19.75 %) and chickpea + linseed 2:1 (19.75 %) intercropping system. Protein yield (kg ha^{-1}) influenced significantly by the intercropping. The maximum protein yield of chickpea (292 kg ha^{-1}) was recorded with sole chickpea. This was significantly higher than the chickpea + Linseed 2:1 (234 kg ha^{-1}) and chickpea + Linseed 1:1 (97 kg ha^{-1}). Among the cropping modules the highest protein content (16.0 %) was recorded with inorganic cropping module. This was significantly higher than the organic (15.0 %) and natural module (15.0 %) whereas the lowest protein content was recorded with control (13.75%). The highest protein yield of chickpea (215 kg ha^{-1}) was recorded with inorganic cropping module. This was significantly higher than the organic (171 kg ha^{-1}) and natural module (157 kg ha^{-1}). Whereas the lowest protein yield was recorded with control (80 kg ha^{-1}). Similar result was found by Kumar and Singh (2006); Tanwar *et al*. (2011); Siddaram (2012); Basavaraj *et al.* (2015); Nagar *et al*. (2016).

Oil content and yield. The data presented in (Table 2 and Fig. 2) revealed that the oil content (%) influenced significantly by the intercropping. The highest oil content (41.75 %) was recorded with sole linseed which was significantly at par with the chickpea + linseed 1:1 (41.25 %) and chickpea + linseed 2:1 (40.50 %) intercropping system. Oil yield (kg ha^{-1}) influenced significantly by the intercropping. The maximum oil yield (59926 kg ha^{-1}) was recorded with sole linseed. This was significantly higher than the chickpea + Linseed 1:1 (50222 kg ha^{-1}) and chickpea + Linseed 2:1 (31178 kg ha^{-1}). Among the cropping modules the highest oil content (32.50 %) was recorded with inorganic cropping module which was significantly at par with the organic (32.25 %) and natural module (30.50 %) module. Whereas the lowest oil content was recorded with control (28.25 %). The highest oil yield (43103 kg ha^{-1}) was recorded with inorganic cropping module which was significantly at par with the organic module (41949 kg ha^{-1}). Whereas the lowest oil yield was recorded with control (21887 kg ha^{-1}). Similar result was reported by Kumar and Singh (2006); Abraham *et al.* (2011).

Table 2: Effect of cropping system and row ratio on protein content (%) and yield (kg ha^{-1}), and oil (%) content and yield (kg ha^{-1}) of chickpea and linseed.

Treatments	Chickpea		Linseed	
	Protein Content (%)	Protein Yield (kg ha^{-1})	Oil Content (%)	Oil Yield (kg ha^{-1})
Intercropping system				
Sole Chickpea	20.25	292	-	-
Sole Linseed	-	-	41.75	59926
Chickpea + Linseed 1:1	19.75	97	41.25	50222
Chickpea + Linseed 2:1	19.75	234	40.50	31178
SEm±	*0.44*	*3.44*	*0.72*	*864.41*
CD (P=0.05)	**1.53**	**11.90**	**2.50**	**2991.25**
Cropping system modules				
Control	13.75	80	28.25	21887
Inorganic module	16.00	215	32.50	43103
Organic module	15.00	171	32.25	41949
Natural module	15.00	157	30.50	34385
SEm±	*0.29*	*3.49*	*0.62*	*809.84*
CD (P=0.05)	**0.84**	**10.17**	**1.81**	**2363.74**

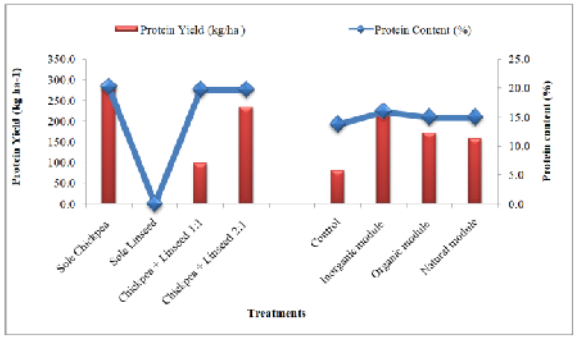

Fig. 1. Effect of cropping system and row ratio on protein content (%) and yield (kg ha^{-1}), and oil (%) content and yield (kg ha^{-1}) of chickpea.

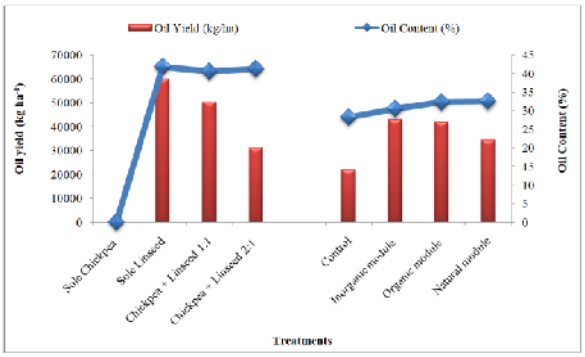

Fig. 2. Effect of cropping system and row ratio on protein content (%) and yield (kg ha^{-1}), and oil (%) content and yield (kg ha^{-1}) of linseed.

CONCLUSION

In the light of the results obtained from this investigation it can be concluded that chickpea and linseed both performed individually better in sole stand Among the intercropping system the chickpea + linseed with the ratio of 2:1 performed significantly higher growth parameters, quality and nutrient uptake. Whereas linseed performed better in 1:1 ratio. In the cropping module Inorganic module performed better than organic and natural module, but according to soil health organic and natural module is beneficial.

FUTURE SCOPE

In order to arrive at a meaningful recommendation, these results are only indicative and require further experiments on the effect of chickpea + linseed intercropping and cropping modules on growth, yield and quality in chickpea + Linseed need to be reported for one more year.

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Conflicts of Interest. None.

REFERENCES

Abraham, T., Thenua, O. V. S. and Sharma, U. C. (2011). Evaluation performance of chickpea and mustard

intercropping system viz.-a-viz. their sole crops as influenced by irrigation regimes and fertility gradients. *Indian Journal of Agricultural Sciences, 81*(8): 772-775.

Agriculture Statistics at a Glance, Government of India report, (2021).

Anand, M. G., Reddy, V. C. and Kalyanmurthy, K. N. (2004). Effect of different nutrient sources on growth and yield of groundnut. *Environmental Ecology, 22*(4): 631-635.

Anshul, L. (2018). Effect of liquid organic manure 'jeevamrit' on the productivity of wheat under zero budget natural farming system. *M.Sc. (Agri) Thesis*, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya Palampur.

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

Basavaraj, K., Deveakumar, N., Latha, B. and Somanatha, A. C. (2015). Effect of organic liquid manure, jeevamrutha and panchagavya on yield of Frenchbean (*Phaseolus vulgaris* L.). *National Symposium on Organic Agriculture* Tamil Nadu, p. 111.

Biradar, S. A., Kumar, K. A., Rajanna B. and Shubha, G. V. (2015). Economic feasibility of intercropping of linseed (*Linum usitatissimum* L.) and chickpea under rainfed condition. *Green Farming, 6*(3): 601-603.

Chaudhary, S. (2010). Response of promising linseed varieties to nitrogen. *Asian Journal of Bio Science, 4* (2): 210-211.

Department of Agriculture Cooperation and Farmers Welfare report, (2021). Food and Agriculture Organization Statistics report, (2020).

Gan, Y. T., Warkentin, T. D., McDonald, C. L., Zentner, R. P. and Vandenberg, A. (2009). Seed Yield and Yield Stability of Chickpea in Response to Cropping Systems and Soil Fertility in Northern Agric. and Agri-Food Canada. *Agronomy Journal, 5*(101): 1113-1122.

Kalaghatagi, S. B., Guggari, A. K., Kambrekar, D. N. and Kadasiddappa Malamsuri (2017). Performance of Linseed based intercropping systems in different Row Ratio under Semi Arid Region of Karnataka. *Indian Journal of Dryland Agricultural Research and Development, 32*(1): 26-31.

Kumar, A., and Singh, B. P. (2006). Effect of row ratio and phosphorus level on performance of chickpea (*Cicer arietinum*) + Indian mustard (*Brassiaca juneca*) intercropping. *Indian Journal of Agronomy, 51*(2): 100-102.

Ministry of Agriculture and Farmers Welfare, Government of India report, (2020).

Nagar, R. K., Goud, V. V., Rajesh K. and Ravindra K. (2016). Effect of organic manures and crop residue management on physical, chemical and biological properties of soil under pigeonpea based intercropping system. *International Journal of Farm Sciences, 6*(1): 101-113.

Siddappa, Murali, K. and Devakumar, N. (2016). Organically grown field bean (*Lablab purpureus Var. Iignosus*) using jeevamrutha and farm yard manure. *National Conference on Sustainable and Self Sufficient Production of Pulses through Integrated Approach*, Bengaluru. 105.

Sharma, R. K. and Goswami, V. K. (2010). Comparative performance of chickpea and linseed in their pure and intercropping system. *Green Farming, 1*(2): 128-131.

Shyamrao, K., Upperi, S. N. and Jadhav, R. L. (2016). Greengram productivity enhancement through foliar spray of nutrients. *Legume Research, 39*(5): 814-816.

Siddaram (2012). Effect of farm yard manure and bio-digester liquid manure on the performance of aerobic rice-fieldbean cropping sequence. *Ph.D. Thesis (Unpub.), University of Agricultural Science***,** Bangalore, Karnataka, India.

Singh, B. and Aulakh, C. S. (2017). Effect on growth and yield of intercrops in wheat + chickpea intercropping under limited nutrition and moisture. *Indian Journal of Ecology, 44*(Special Issue-5): 507-511.

Singh, K. K. and Rathi, K. S. (2003). Dry matter production and productivity as influenced by staggered sowing of mustard intercropped at different row ratios with chickpea. *Journal of Agronomy Crop Science, 189*: 169-175.

Tanwar, S. P. S., Rokadia, P., and Singh, A. K. (2011). Effect of row ratio and fertility levels on the performance of chickpea (*Cicer arietinum*) and linseed (*Linum usitatissimum*) intercropping system under rainfed condition. *Indian Journal of Agronomy, 56*(3): 87-92.

Tripathi, H. N., Chand, S. and Tripathi, A. K. (2005). Biological and economical feasibility of chickpea (*Cicer arientinum*) + Indian mustard (*Brassica juncea*) cropping systems under varying levels of phosphorus. *Indian Journal of Agronomy, 50*(1): 31-34.

Varshney, J. G. and Arya, R. L. (2004). Effect of integrated nutrients use and weed control methods on sole gram (*Cicer arietinum*) and gram + Indian mustard (*Brassica juncea*) intercropping system. *Indian Journal Agriculture Science, 74*(3): 121-125.

Yadav, J. K., Sharma, M., Yadav, R. and Yadav, S. K. (2017). Effect of different organic manures on growth and yield of chickpea (*Cicer arietinum* L.). *Journal of Pharmacognosy and Phytochemistry, 6*(5): 1857-1860.

Yadav, S., Mohan, L., Naresh, R. K., Yadav, R. B., Yadav, A. K., Yadav, K. G., Rahul, K., Chandra, S. M. and Pradeep, R. (2019). Effect of organic and inorganic nutrient sources on productivity, grain quality of rice and soil health in North-West IGP. *International Journal Current Microbiology Applied Science, 8*(12): 2488-2514.

Wasu, R. M., Gokhale, D. N., Dadgale, P. R. and Kadam, G. T. (2013). Effect of chickpea based intercropping systems on competitive relationship between chickpea and intercrop. *International Journal Agriculture Science, 9*(1): 351-353.

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