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Effect of organic and inorganic nutrient application in vegetable pea on growth, yield and net return from succeeding maize in vegetable pea–maize cropping sequence

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ABSTRACT

A two years field experiment was conducted during Rabi and Kharif seasons of 2014-15 and 2015-16 to study the effect of integrated nutrient management practices in vegetable pea-maize cropping sequence on experimental farm of the College of Post graduate Studies (CAU-I), Umaim (Meghalaya). In this investigation, residual effect of organic and inorganic nutrient sources applied in vegetable pea, was assessed on growth, yield and net return from succeeding maize. The experiment was laid out in factorial randomized block design on maize variety "DA 61A". This study included three reatments *viz.* farmyard manure (FYM) (5 t ha^{-1}) (B1), Rhizobium + Phosphorus solubilizing bacteria (PSB) (B2) and FYM (5 t ha^{-1}) + Rhizobium + PSB (B3) under organic sources and six treatments *viz.* recommended dose of fertilizer (RDF) (F1), RDF + Lime (0.5 t ha^{-1}) (F2), 75 % RDF (F3), 75 % RDF + Lime (0.5 t ha^{-1}) (F4), 50% RDF (F5) and 50 % RDF + Lime (0.5 t ha^{-1}) (F6) under inorganic nutrient source to preceding vegetable pea. Maize was grown as a succeeding crop after pea harvest with 50% of recommended dose of N, P and K fertilizers (RDF) to maize. The result shown that both the nutrient sources applied to preceding vegetable pea crop had significant effect on growth, yield attributes and yields of succeeding maize in both the years. B3 application in pea was at par with B1 (FYM 5 t ha^{-1}) application to pea but significantly more over B2 application to pea in both the years. Among inorganic nutrient application to preceding pea, F2 recorded maximum grain yields in succeeding maize which was at par with F1, F3 and F4 applications to pea in first year but significantly more over the maize grain yield recorded from F5 and F6 application to pea. In second year again F2 recorded maximum grain yields in succeeding maize which was at par with F1 and F4 applications to pea but significantly more over the F3, F5 and F6 application to pea. Net return ('000₹` ha^{-1}) recorded from maize from B3 organic treated plots was 13.37 and 14.12 and through F2 inorganic treated plots was 17.4 and 16.0 on succeeding maize in first and second year, respectively. Interaction between organic and inorganic nutrient sources applied to vegetable pea was also found significant for in second year when maximum grain yield (3.82 t ha^{-1}) and net return (₹22.46' 000 ha^{-1}) of succeeding maize was obtained with the combine application of biofertilizers + FYM 5 t ha^{-1} + RDF + Lime 0.5 t ha-1 (B3F2).

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1. Introduction

Maize (*Zea mays* L.) is a versatile cereal crop grown all over the world with wide adaptability. Besides a staple food for human beings, it is also a significant animal and poultry feed and has enormous industrial importance for various uses. This is the second most important crop after rice in North eastern hill region of India in terms of its area coverage and contribution to total food grains production. However, in the northeastern hill region in general and especially in the state of Meghalaya, maize productivity is much below the national average. There are many factors which are responsible for controlling crop productivity. Providing adequate supply of mineral nutrition in optimum amount is the one of the most important one. The productivity of crop in recent years is in decreasing order because of decline in soil fertility status. Inorganic fertilizers mainly urea, SSP, MOP and different types of bulky organic manures such as, farmyard manure, compost and green manures and biofertilizers are normally used to increase soil productivity. There is a need to replace the high use of synthetic fertilizers by organic sources of nutrients to sustain soil health. Organic matter is considered as life of the soil, and also favors sustainable productivity (Behera *et al.*, 2007). So incorporation of plant residues particularly N_2 - fixing legumes is a useful method to sustain organic matter content and thereby enhance the biological activity, improve soil fertility and increase nutrient availability to succeeding crop (Giller *et al.,* 1997). Vegetable pea is grown for their fresh green pods, for livestock forage and as soil-enhancing green manure. Legumes, such as vegetable pea, are significant as it has the ability to fix atmospheric nitrogen through symbiotic nitrogen-fixing bacteria present in structures called root nodules (Sanginga *et al.,* 1996). Unfortunately legumes incorporation in the soil has been slowly eliminated from cropping systems, and has led to serious consequences on soil fertility. Despite leguminous crop great potential for making significant N contributions and improving productivity when added with other organic and inorganic nutrient sources, adoption of legumes is poor due to wide range of socio economic and physical constraints. Cultivation of vegetable pea and maize in sequence for fresh green pods, fodder or green manure and maize grains can positively influence the structure and functioning of the agro-ecosystem. Campiglia *et al.* (1999) reported that several studies have shown that crop yield and product quality are usually improved when legume are grown as a preceding crop. Keeping in view the importance of integrated nutrient management practices along with incorporation of vegetable pea biomass, the present experiment was designed to study the residual effect of organic and inorganic nutrient sources applied to vegetable pea on growth, yield and net return from succeeding maize.

2. Materials and Methods

A field experiment was conducted consecutive for two years on the experimental farm of College of Post Graduate Studies (CAU-I), Umiam (Meghalaya) during 2014-15 and 2015-16 to study the effect of integrated nutrient management practices in vegetable pea-maize cropping sequence. Residual effect of application of organic and inorganic nutrient sources in vegetable pea was also assessed on succeeding maize in. The experiment was carried out in factorial randomized block design (RBD) consisting of three organic nutrient sources viz., FYM (5 t ha^{-1}) (B_1), *Rhizobium* + Phosphorus solubilizing bacteria (PSB) (B_2) and FYM (5 t ha^{-1}) + *Rhizobium* + PSB (B_3) and six inorganic nutrient treatments viz., RDF (F_1), RDF + Lime (0.5 t ha^{-1}) (F_2), 75 % RDF (F_3), 75 % RDF + Lime (0.5 t ha^{-1}) (F_4), 50 % RDF + Lime (F_5) and 50 % RDF (0.5 t ha^{-1}) (F_6) , replicated thrice. Recommended doses of fertilizers for vegetable pea was 20:60:40 kg $N:P_2O_5:K_2O$ $ha^{-1.}$ After pea harvest, maize was grown as succeeding crop with 50% RDF of N, P and K fertilizers to maize (40:30:20 kg $N:P_2O_5:K_2O$ ha^{-1}) to assess the residual effect of nutrients applied to vegetable pea. N, P and K were applied through urea, single super phosphate (SSP) and murate of postash (MOP). Both the crops were grown with recommended agronomic practices except for variable treatments. Plant heights of five randomly selected plants were measured from the base of the plant to the top of the tassel at harvest and their means were calculated. Dry matter productions of plants was recorded at harvest from five plants selected randomly from each plot from border rows and then cut from the base and then dried in the shade for 24-48 hours. After that, samples were oven dried at 65^{o}C till a constant weight was obtained and expressed in g $plant^{-1}$.

Leaf area index is defined as leaf area per unit land area. It was calculated by using following formula (Mauro et al., 2001).

$$\text{Leaf Area Index} = \frac{Leaf\ area\ per\ plant\ (cm^2)}{Leaf\ area\ per\ plant\ (cm^2)}$$

Yield attributes such as number of cobs $plant^{-1}$, number of kernels cob^{-1}, test weight and grain weight (g $plant^{-1}$) were recorded at harvest of succeeding maize. Grain yield was recorded from cobs harvested from net plot area of each treatment which were allowed to sun drying for 8-10 days and thereafter, grains were separated from these cobs, cleaned and weighed in kg later converted into grain yield (kg plot^{-1}) was converted to t ha^{-1}. The harvest index was calculated by dividing the economic (grain) yield by biological yield (Donald, 1962) as described below –

$$Harvest\ index\ (\%) = \frac{Grain\ \ yield\ (kg\ ha^{-1})}{Biological\ yield\ (kg\ ha^{-1})}$$

Data obtained from various studies were statistically analyzed in RBD design using the technique of Analysis of Variance with the help of computer. The difference between the treatment means was tested for their statistical significance with appropriate critical difference (C.D.) value at 5 per cent level of probability (Gomez and Gomez, 1984).

3. Results and Discussion

Growth parameters

Plant height as shown in table 1 was at par because of organic nutrient sources at harvest stage during both the years. At harvest stage, plant height at F_2 was at par with F_1 in both the years but significantly taller over remaining four inorganic treatments in both the years. Lime application with all levels of RDF resulted in taller maize plants than their no lime respected treatments in both the years. Maximum plant height of succeeding maize was recorded under F_2 (240.96 and 248.78) and minimum under F_5 (182.31 and 223.07) in 2014-15 and 2015-16, respectively. The performance of succeeding maize plant under F_2 might be the result of residual soil fertility improved by the application of RDF + lime + Rhizobium + PSB + FYM with incorporation of vegetable pea or the nodule formation by the roots of vegetable pea as compared to other maize treated plots. These results are in line with those of Balasubramaniyan and Palaniappan, (2001). Leaf area index (LAI) of succeeding maize at 90 DAS during first year was significant where treatment B_3 (4.83) being at par with B_1 (4.51) recorded significantly more LAI in comparison to B_2 (3.91) treatment. However, LAI of succeeding maize differed markedly at 90 DAS stage in both years due to inorganic nutrient sources (a combination of various levels of fertilizers with lime @ 0.5 t ha^{-1}). At 90 DAS in first year, LAI of maize with treatment F_2 was significantly higher over all five inorganic treatments while in second year, F_1 recorded higher LAI which was at par with F_2, F_4, F_3 and F_6 and markedly recorded more LAI over F_5 treatments for LAI in succeeding maize through residual effect of inorganic nutrients applied to vegetable pea. Higher leaf area index was observed in the plots where RDF was applied with lime and incorporation of vegetable pea while lower leaf area index was recorded from 50% RDF plots. This is might be due to residual soil nitrogen contents by the legumes incorporation and decomposition and increase soil pH. The results are in consistent with that of Arif *et al.* (2011) whose study was to check the effect of residues on the yield and yield components of maize crop. Dry matter production in succeeding maize (g plant^{-1}) was recorded at harvest stage during both the years of experiment differed significantly both due to organic and inorganic nutrient sources at harvest stages during both the years after vegetable pea experimental trial. Succeeding maize in treatment B_3 produced more dry matter which was at par with B_1 but significantly more over the dry weight recorded from B_2 treatment at harvest stage in both the years. Dry matter accumulation in succeeding maize at harvest (table 1) differed markedly in both years due to inorganic nutrient sources (a combination of various levels of fertilizers with lime @ 0.5 t ha^{-1}) where F_2 was found to be at par with F_1 and significant over all the other inorganic nutrient treatments. However, in second year treatment F_2 was significantly superior to all the other inorganic treatments. Lime application with all levels of RDF resulted in relatively more production of dry weight in plants than their no lime respected treatments in both the years.

Yield attributes

The data of succeeding maize yield attributes such as number of cobs plant^{-1}, number of kernels cob^{-1}, test weight (g) and grain weight (g plant^{-1}) were recorded during 2015 and 2016 (Table 2). Significant difference was observed in number of cobs plant^{-1} in first year, number of kernels cob^{-1} in second year and grain weight plant^{-1} in both years in succeeding maize through the application of organic nutrient sources to vegetable pea. However, significant difference through residual effect of inorganic nutrient sources applied to pea on succeeding maize for number of cobs plant^{-1}, test weight (g) and grain weight (g plant^{-1}) in both years of the experimental trial. Maximum yield attributing characters in succeeding maize was observed under B_3 treated organic plots. Maximum (1.13) and minimum cobs per plant was observed from B_3 and lowest B_1 (0.98), respectively through organic residual effect on succeeding maize. The magnitude of difference B_3 had over B_1 and B_2 was 21.49 and 32.46 %, and, 10.71 and 28.76 %, during first and second year, respectively for grain weight plant^{-1}. Maximum number of number of cobs plant^{-1}, test weight and grain weight plant^{-1} was obtained under F_2 which was found to more than the other treatments recorded from the application of inorganic nutrients applied to vegetable pea

Table 1. Plant height, dry matter accumulation and LAI of succeeding maize as influenced by application of organic and Inorganic nutrient sources to preceding vegetable pea in vegetable pea-maize cropping sequence

Treatments	**Plant height (cm)**		**Dry matter production (g plant^{-1}) at harvest**		**Leaf area index at 90 DAS**	
	1st Year	**2nd Year**	**1st Year**	**2nd Year**	**1st Year**	**2nd Year**
A. Organic sources						
FYM (B_1)	214.36	235.16	167.25	165.54	4.51	5.02
Rhizobium +PSB (B_2)	208.82	233.95	159.59	150.10	3.91	5.01
Rhizobium+PSB+FYM (B_3)	220.94	239.61	183.46	177.64	4.83	5.41
SEm±	**4.53**	**2.88**	**6.00**	**4.42**	**0.15**	**0.14**
CD (P=0.05)	**NS**	**NS**	**17.26**	**12.71**	**0.45**	**NS**
B. Inorganic sources						
RDF (F_1)	227.81	246.29	208.53	194.26	5.09	5.68
RDF+Lime (F_2)	240.96	248.78	231.74	221.46	6.58	5.63
75%RDF (F_3)	210.95	234.10	159.91	152.27	3.82	5.07
75%RDF+Lime (F_4)	220.68	236.34	169.96	164.26	4.47	5.20
50%RDF (F_5)	182.31	223.07	115.42	112.82	3.01	4.57
50%RDF+Lime (F_6)	205.51	228.86	135.05	141.51	3.53	4.75
SEm±	**6.41**	**4.07**	**8.49**	**6.26**	**0.22**	**0.19**
CD (P=0.05)	**18.43**	**11.71**	**24.40**	**17.98**	**0.63**	**0.55**

and its residual effect on succeeding maize. In inorganic nutrient sources, maximum number of cobs plant^{-1} was found to associate with treatment F_2 (1.27 and 1.34) which was at par with F_1 (1.19 and 1.17) but significantly more in numbers over the cobs recorded from F_3, F_4 and F_5 and F_6 treatments in both the years. Among inorganic sources, treatment F_2 recorded maximum test weigh in the investigation which was at par with F_1 but significantly more over the treatments F_3, F_4, F_5 and F_6 in first year. In second year, F_2 was at par with F_1 and F_4 but significantly high test weight over F_3, F_5 and F_6. Among inorganic sources, maize kernel weight plant^{-1} in F_2 treated pea was significantly more over the kernels weight plant^{-1} recorded from all the remaining inorganic treatments applied pea in both the years. Minimum kernels weight cob^{-1} was observed from F_5 treatment in both the years. The magnitude of difference the F_2 had over F_1, F_3, F_4, F_5 and F_6 was 20.00, 73.13, 49.67, 237.82 and 166.58 % and 23.45, 60.62, 52.60, 213.62 and 124.44 %, during first and second year, respectively. The data in table 4 revealed that the interaction between organic and inorganic nutrient application to pea brought a significant difference in kernel weight plant^{-1} of succeeding maize in first year when a combine application of B_3F_2 (*Rhizobium* + PSB + FYM 5 t ha^{-1}+ RDF + Lime 0.5 t ha^{-1}) applied to preceding pea produced significantly more kernel weight plant^{-1} over all other application of combinations of organic and inorganic nutrient sources to pea crop. Second high kernel weight plant^{-1} in maize was observed from B_1F_1 application to pea crop which was also significantly high over the remaining application of organic and inorganic nutrient combinations to pea.

Yields

Grain yield of maize varied significantly both due to organic and inorganic nutrients application in preceding pea crop in both the years and also on the basis of pool analysis (table 3). In residual effect of organic nutrient sources to pea, maize grain yield from B_3 (*Rhizobium* + PSB + FYM 5 t ha^{-1}) application in pea was at par with B_1 (FYM 5 t ha^{-1}) application to pea but significantly more over B_2 (*Rhizobium* + PSB) application to pea in both the years. However, on pool basis, B_3 application in pea recorded significantly more maize grain yield over both B_1 and B_2 treated pea plots. Treatment B_3 application in pea recorded 6.6 and 5.6% and 10.2 and 22.5% increase in grain yield of maize over the application of B_1 and B_2 nutrients in pea during first year and second year of experiments, respectively. On pooled basis, B_3 treatment in pea produced 6.3 and 16.2% more maize grain yields over B_1 and B_2 nutrients in pea. Among inorganic nutrient application to preceding pea, F_2 (RDF + Lime) recorded maximum grain yields in succeeding maize which was at par with F_1, F_3 and F_4 applications to pea in first year but significantly more over

Treatments	No. of cobs plant^{-1}		No. of kernels cob^{-1}		Test weight (g)		Grain weight (g plant^{-1})	
	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year
A. Organic sources								
FYM (B_1)	1.00	1.06	312.07	340.99	224.73	223.02	70.16	71.18
Rhizobium +PSB (B_2)	0.98	1.02	301.34	305.41	217.64	215.62	64.35	61.20
Rhizobium+PSB+FYM (B_3)	1.13	1.09	317.14	338.96	230.51	228.11	85.24	78.80
SEm±	**0.04**	**0.04**	**11.12**	**9.64**	**8.18**	**9.24**	**2.12**	**3.12**
CD (p=0.05)	**0.12**	**NS**	**NS**	**27.70**	**NS**	**NS**	**6.09**	**8.96**
B. Inorganic sources								
RDF (F_1)	1.19	1.17	361.81	355.33	239.11	240.62	97.66	88.81
RDF+Lime (F_2)	1.27	1.34	376.70	374.46	266.58	250.31	117.19	109.64
75%RDF (F_3)	0.99	1.07	309.86	326.04	219.51	213.47	67.69	68.26
75%RDF+Lime (F_4)	1.07	1.11	343.85	338.92	229.24	230.13	78.30	71.85
50%RDF (F_5)	0.77	0.75	215.96	272.64	191.56	194.71	34.69	34.96
50%RDF+Lime (F_6)	0.94	0.90	252.92	303.34	199.78	204.27	43.96	48.85
SEm±	**0.06**	**0.06**	**15.72**	**13.63**	**11.57**	**13.06**	**3.00**	**4.41**
CD (p=0.05)	**0.18**	**0.16**	**45.19**	**39.17**	**33.26**	**37.54**	**8.61**	**12.68**

Table 2. Yield attributes of succeeding maize as influenced by application of organic and inorganic nutrient sources to preceding vegetable pea in vegetable pea-maize cropping sequence

the maize grain yield recorded from F_5 and F_6 application to pea. In second year again and also on pool basis, F_2 recorded maximum grain yields in succeeding maize which was at par with F_1 and F_4 applications to pea but significantly more over the maize grain yield recorded from F_3, F_5 and F_6 application to pea. On mean basis, F_2 application to pea recorded 3.2, 7.9, 6.3, 55.0 and 37.6%; 6.0, 10.2, 6.7, 38.4 and 28.4% and 5.0, 8.8, 6.5, 46.2 and 32.7% higher maize grain yield in first year, second year and on pooled analysis basis of experimental data, respectively. This was similar to the findings of Yusuf *et al.* (2009).

The data in table 4 shown a positive interaction between organic and inorganic nutrient application to vegetable pea brought for grain yield of succeeding maize in second year when a combine application of B_3F_2 (*Rhizobium* + PSB + FYM 5 t ha^{-1}+ RDF + Lime 0.5 t ha^{-1}) applied to preceding pea produced maximum grain yield (3.82) which was at par with B_3F_1, B_1F_1, B_1F_2 and B_1F_3 but significantly high over all other combinations of organic and inorganic nutrient sources application to preceding pea crop. Further, F_2 and F_5 combinations with all three organic sources recorded maximum and minimum grain yield of maize in succeeding maize in this year except B_2 association with F_4. Stover yield was found to show significant difference with the application of organic nutrient sources only in the first year and pooled analysis. However, with the application of inorganic nutrient sources, stover maize yield was found to show significant difference in both the years and in pooled data. Relatively, higher stover yield of maize was recorded in the first year experimental trial as compared to the second year maize trial. In the first year, application of biofertilizers with FYM treatment (B_3) recorded maximum maize stover yield (6.98) which was found at par with B_1 (6.38) but significantly higher than B_2 (6.05) treatments. However, pooled data analysis showed that B_3 (6.62) was significantly superior to both B_1 and B_2 stover yield of maize. Among inorganic nutrient sources, maximum stover yield in this experiment was observed from the plots where F_2 inorganic nutrient was applied pea in both the years. In first year and pooled analysis, stover yield of maize in F_2 applied pea plots was at par with F_1 applied pea plots but significantly more over the stover yield obtained from F_3, F_4, F_5 and F_6 applied pea plots. However, in second year, maize stover yield in F_2 applied pea plot was at par with F_1 and F_4 but significantly high over F_3, F_5 and F_6 treatment applied pea crops. This result was in similar to the findings of Saini *et al.* (2005). Through inorganic nutrient sources maximum stover yield (8.17 and 6.97) was recorded under F_2 and minimum (4.37 and 4.82) under F_5 treatments in first and second year, respectively. Harvest index of maize did not varied significantly due to organic or inorganic nutrient application to preceding pea in both years and pooled analysis of succeeding maize experiment.

Table 3. Yield and economic return of succeeding maize as influenced by application of organic and inorganic nutrient sources to preceding vegetable pea in vegetable pea-maize cropping sequence

Treatments	**Grain yield (t ha^{-1})**		**Stover yield (t ha^{-1})**		**Biological yield (t ha^{-1})**		**Harvest index**		**Net return (000' ₹ha^{-1})**		**B:C ratio**	
	1st Year	**2nd Year**	**1st Year**	**2nd Year**	**1st Year**	**2nd Year**	**1st Year**	**2nd Year**	**1st Year**	**2nd Year**	**1st Year**	**2nd Year**
A. Organic sources												
FYM (B_1)	3.05	3.04	6.38	5.89	9.43	8.92	32.68	34.02	10.7	11.7	11.2	1.46
***Rhizobium* +PSB (B_2)**	2.95	2.62	6.05	5.68	9.01	8.29	33.10	31.93	9.4	6.0	7.7	1.32
***Rhizobium*+PSB+FYM (B_3)**	3.25	3.21	6.98	6.26	10.24	9.47	32.47	33.99	13.4	14.1	13.7	1.45
SEm±	**0.08**	**0.07**	**0.24**	**0.20**	**0.23**	**0.21**	**1.11**	**0.93**	**1.1**	**1.0**	**0.7**	**0.04**
CD (p=0.05)	**0.24**	**0.20**	**0.68**	**NS**	**0.67**	**0.60**	**NS**	**NS**	**3.2**	**2.8**	**2.1**	**0.11**
B. Inorganic sources												
RDF (F_1)	3.44	3.16	7.90	6.50	11.35	9.66	30.30	32.59	15.9	13.4	14.7	1.54
RDF+Lime (F_2)	3.55	3.35	8.17	6.97	11.72	10.32	30.43	32.62	17.4	16.0	16.7	1.58
75%RDF (F_3)	3.29	3.04	6.51	5.92	9.80	8.96	34.67	33.81	13.9	11.8	12.8	1.47
75%RDF+Lime (F_4)	3.34	3.14	6.71	6.23	10.05	9.38	33.35	33.76	14.6	13.2	13.9	1.49
50%RDF (F_5)	2.29	2.42	4.37	4.82	6.67	7.24	34.47	33.48	0.7	3.3	2.0	1.02
50%RDF+Lime (F_6)	2.58	2.61	5.17	5.20	7.75	7.81	33.28	33.63	4.5	5.9	5.2	1.15
SEm±	**0.12**	**0.10**	**0.33**	**0.28**	**0.33**	**0.30**	**1.58**	**1.32**	**1.6**	**1.4**	**1.0**	**0.05**
CD (p=0.05)	**0.34**	**0.29**	**0.96**	**0.82**	**0.94**	**0.85**	**NS**	**NS**	**4.5**	**3.9**	**3.0**	**0.15**

Economic return

Among the organic nutrient sources application to preceding vegetable pea and its residual effect on succeeding maize, gross and net return from maize experiment was observed to show no significant difference except for gross return in the second year trial of vegetable pea-maize cropping sequence (Table 4). Relatively through residual effect of organic sources, response of maize in terms of economic return was higher under *Rhizobium* + PSB + FYM 5 t ha^{-1}. Significant difference was recorded through application of inorganic sources in preceding pea and its residual effect on succeeding maize for gross return, net return and B:C ratio in both years and in pooled analysis. Maximum net return (95.2 and 86.7) by succeeding maize was recorded from treatment RDF + Lime 0.5 t ha^{-1} (F_2) recorded and minimum (58.0 and 48.23) under 50% RDF in first and second year of succeeding maize trial. B:C ratio of succeeding maize on the other hand recorded maximum (3.38 and 3.18) under F_1 treatment and minimum (2.57 and 2.18) under 50% RDF + Lime through residual effect of inorganic sources application to vegetable pea in first year and second year, respectively. Interaction between organic and inorganic nutrient sources application to vegetable pea and its residual effect on succeeding maize (Table 4a) was also found to show significant difference in the second year trial of succeeding maize where *Rhizobium* + PSB + FYM 5 t ha^{-1} + RDF + Lime 0.05 t ha^{-1} (B_3F_2) recorded higher net return of 22.46 with B:C ratio of 1.76. It can be concluded that vegetable pea cultivated as preceding legume with RDF, lime, biofertilizers and FYM have significantly increased the growth, yield attributes, yield and net returns of succeeding maize where best treatment through organic sources application was recorded from *Rhizobium* + PSB + FYM 5 t ha^{-1} and through inorganic sources application from RDF + Lime 0.5 t ha^{-1} in north eastern hills of Meghalaya.

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Table 4. Interaction between organic and inorganic sources applied in vegetable pea and their residual effect on kernel weight plant^{-1}, grain yield and net return of succeeding maize in second year in vegetable pea-maize cropping sequence

Treatments	**Kernel weight (g plant^{-1}) (1st Year)**			**Grain yield (t ha^{-1}) (2nd Year)**			**Net return ('000 ₹ ha^{-1}) (2nd Year)**		
Organic / Inorganic	**FYM (B_1)**	***Rhizobium* +PSB (B_2)**	***Rhizobium*+ PSB+FYM (B_3)**	**FYM (B_1)**	***Rhizobium* +PSB (B_2)**	***Rhizobium*+ PSB+FYM (B_3)**	**FYM (B_1)**	***Rhizobium* +PSB (B_2)**	***Rhizobium*+ PSB+FYM (B_3)**
RDF (F_1)	90.70	81.77	120.52	3.48	2.49	3.51	17.8	4.2	18.1
RDF+Lime (F_2)	111.31	94.96	145.30	3.55	2.67	3.82	18.8	6.8	22.5
75%RDF (F_3)	65.16	59.91	78.01	3.23	2.54	3.35	14.3	5.0	16.0
75%RDF+Lime (F_4)	73.55	74.25	87.11	3.07	3.05	3.31	12.2	11.9	15.5
50%RDF (F_5)	35.82	30.02	38.23	2.36	2.28	2.62	2.5	1.4	6.1
50%RDF+Lime (F_6)	44.45	45.19	42.24	2.52	2.66	2.66	4.7	6.6	6.6
Sem±	**5.19**			**0.17**			**2.4**		
CD (p=0.05)	**14.91**			**0.50**			**6.8**		