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Effect of Pre-harvest foliar spray of micronutrients on growth and fruit characteristics of mango (*Mangifera indica* L.) cv. Langra

Rashmi Panwar and CP Singh

Abstract
The investigation was carried out at the Horticultural Research Centre, Patharchatta of the G.B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand to study the effect of pre-harvest foliar spray of micronutrients on growth and fruit characteristics of mango (*Mangifera indica* L.) cv. Langra. It is found that, combined spray of boron, zinc, iron and copper improved the tree girth, tree spread, number of fruits per tree. However, zinc + iron foliar spray increased the tree volume. Maximum yield in kg/tree was found with zinc and boron individually and in combination with copper.

Keywords: Mango, Langra, foliar application, micronutrients

Introduction
Mango, (*Mangifera indica* L.), the ‘’king of fruits” is the main fruit of Asia and possessing own importance all over the world. It has been in cultivation in the Indian sub-continent for well over 4000 years (De Candolle, 1904) [7]. In India nearly 18.4 million tonnes of mangoes were produced from 2.5 million ha area. Out of the total 7.2 million hectare area, the fruit production in India is 88.98 million tonnes. The productivity of mango in India is low i.e. only 7.3 tonnes per hectare. Mango shares 20.7 percent to total production (Indian Horticulture Data Base, 2013-14). Langra is one of the main commercial cultivars of North India. Foliar feeding is one way to achieve the goal because nutrients can be applied directly to the site of their metabolism and are, therefore, less subjected to various losses as in the case of soil application. Moreover, for rapid response and correction of deficiencies of micronutrients, foliar sprays of nutrients especially Zn, B, Cu and Fe have been used singly and in combination. Foliar feeding is beneficial for accelerating improvement in physico-chemical characters of fruits (Srivastava, 1993) [16].

Materials and Methods
The investigation was carried out in the two years at the Horticulture Research Centre, of the University. The experiment was conducted on 27 years old trees of mango cv. Langra planted at 12 m distance in square system and maintained under uniform cultural practices. The trees were almost uniform in growth and vigour. The soil was well drained, sandy loam having pH (6.9), Zn (0.330 ppm), Fe (23.994 ppm), Cu (2.934 ppm) and B (1.27 ppm). The treatment comprises of two levels of boron (0 and 0.4%), zinc (0 and 0.1%), iron (0 and 0.02%) and copper (0 and 0.05%). These micronutrients were sprayed through foliar application during the month of April and May. Sixteen treatment combinations were replicated thrice and laid out as per randomized block design.

Results and Discussion
Data showed that trees which were sprayed only with 0.4% borax attained maximum plant height (9.52 m) in first year while borax in combination with zinc @ 0.1% and copper @ 0.05% attained maximum plant height (9.90 m) during second year which is similar to the findings of Banik *et. al.* (1997b) [4] who reported that application of boron at higher level of 0.4% + urea 1.0% promoted plant height of the young Fazli mango tree. Ram and Bose (2000) [12] also supported the findings by reporting that the effect was more pronounced, when the nutrients were applied in combination and maximum increase in plant height was recorded with Mg + Cu + Zn treatments in a period of 2 years in the case of mandarin. Therefore, to enhance the tree height, boron, zinc and copper should be applied (Table 1). Maximum tree girth (48.97 cm) was observed under treatment having boron, zinc and copper micronutrients and minimum girth (47.40 cm) under the treatment having only zinc spray @ 0.1% during

first year. In second year trees attained maximum tree girth (51.17 cm) under the treatment having only iron spray @ 0.2% and minimum tree girth (48.43 cm) under the treatment having only zinc application. Banik and Sen (1997) [2] supported the finding by observing that Zn and B promoted trunk girth. Ram and Bose (2000) [12] also recorded that the mean final stem girth of mandarin was maximum with Mg + Cu + Zn + B and Mg + Cu + Zn treatments while the minimum girth was recorded in control. So, boron @ 0.4%, zinc @ 0.1%, iron 2 0.2% and copper @ 0.05% should be used by growers for getting the more tree girth of mango tree (Table 1). Observations (Table 1) revealed that calculated tree volume was minimum (530.98 m^3) under the treatment containing only copper application in first year while in second year it was minimum (595.94 m^3) of control trees. The maximum tree volume (568.86 m^3) during first year and (672.41m^3) in second year was calculated in the treatment having zinc and iron sprays. Skoog (1940) [15] and Tsui (1948) [17] found that zinc is one of the essential micronutrients for plant growth and has been reported to have a definite role in production of natural auxin especially IAA. So, it might be possible that zinc with synergistic effect with iron improve the tree volume. An induced striking improvement in the growth of trifoliate orange seedlings through the application of zinc and iron was recorded by Armstrong (1956) [1] and Khadr *et al*. (1965) [9]. They supported the findings of tree volume in the result. As we know that good growth of tree will increase the tree volume. Therefore, foliar application of zinc @ 0.1% and iron @ 0.2% should be used to promote the tree volume (Table 1). Data recorded (Table 1) on tree spread for North- South and East- West directions showed that North- South spread was maximum (12.85 m) with boron, zinc, iron and copper applications while it was minimum (11.82 m) in control trees during first year. Banik and Sen (1997) [2] observed similar results that zinc and boron promoted spread of the young trees of mango. North- South spread in second year was recorded maximum (13.97 m) in the trees having zinc and iron sprays while minimum (13.00 m) in trees having B + Cu, B + Fe + Cu and B + Zn + Cu treatments combinations. Similarly East- West tree spread was maximum (12.90 m) with application of all four micronutrients and minimum (11.97 m) under control in the first year and the similar observations was recorded for second year. Results of study carried out by Ram and Bose (2000) [12] supported these observations and recorded that zinc alone or in combination with copper significantly increased the spread of the mandarin orange and he also reported maximum spread of canopy (East- West directions) with Mg + Cu + Zn + B (Table 1). So, B, Zn, Fe and Cu should be applied. Data showed that there were minimum number of fruits per tree (381.33 in first year and 690 in second year) in control conditions while maximum number of fruits per tree (1510 in first year and 2501.67 in second year) in treatment having combinations of all the four micronutrients. Similarly Banik *et al.* (1997a) [3] found that all the micronutrients significantly influenced flowering, fruiting and fruit size. Plants treated with 0.4% Zn in combination with Fe and B at 0.1% produced the maximum number of fruits per tree. While for the role of copper in increasing the number of fruits per tree, there is a contradiction in the findings of several scientists. Singh and Khan (1990) [14] observed that fruit numbers were decreased with copper application alone or in combination with B + Zn while Chattopadhyay and Gogoi (1990) [6] obtained higher fruits per plant than control in papaya following foliar sprays of copper. Hence, B, Zn, Fe and Cu foliar sprays are beneficial to enhance the number of fruits per tree (Table 2). The data on yield (kg/tree) presented in Table 2 indicated that control trees were having minimum yield (95.33 kg/tree and 172.50 kg/tree) in both the years. While maximum yield (377.50 kg/tree and 625.42 kg/tree) were found in treatment combination including all the four micronutrients. Rajput and Chand (1976) [11] showed that pre-flowering spray with 0.3% ZnSO4 and 0.4% boric acid increased the fruit yield in guava. Similarly, Kundu and Mitra (1999) [10] concluded that combined spraying of Cu + B + Zn was found most effective in increasing the yield, fruit weight and size. Interactions of boron, zinc, iron and copper showed that boron and zinc individually in both the years gave significant effect on yield. Similarly, Rath *et.al.* (1980) [13] reported an increase in yield of Langra mango fruits by spraying trees with zinc sulphate alone or in combination with boric acid at the peak period of flowering. While Banik *et.al.* (1997a) [3] showed maximum number of fruits and yield per tree in mango cv. Fazli with the application of highest level of zinc (0.4%) with lowest level of boron (0.1%). Brahamchari *et.al.* (1997) [5] also observed maximum fruit yield with zinc sulphate (0.1%) closely followed by borax (0.4%). Therefore, zinc and boron alone and in combination with copper should be used to increase the yield (kg/tree).

Table 1: Effect of foliar spray of micronutrients on growth characters of mango cv. Langra

Treatment	Tree height (m)		Tree girth (cm)		Tree volume (m^3		Tree spread (m)			
							N-S		E-W	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
$B_0Zn_0Fe_0Cu_0$	8.67	9.03	47.97	50.77	532.24	595.94	11.82	13.47	11.97	13.03
$B_0Zn_0Fe_0Cu_1$	8.83	9.17	47.77	48.67	530.98	616.18	12.07	13.53	12.60	13.20
$B_0Zn_0Fe_1Cu_0$	9.03	9.43	48.33	51.17	535.50	619.23	12.55	13.07	12.53	13.33
$B_0Zn_0Fe_1Cu_1$	9.20	9.57	48.93	50.17	532.31	625.57	12.22	12.93	12.58	13.50
$B_0Zn_1Fe_0Cu_0$	8.82	9.20	47.40	48.43	541.06	632.35	12.80	13.50	12.77	13.53
$B_0Zn_1Fe_0Cu_1$	9.47	9.93	47.67	48.83	553.89	663.01	12.70	12.90	12.87	13.70
$B_0Zn_1Fe_1Cu_0$	9.32	9.73	47.57	48.63	568.86	672.41	13.22	13.97	12.25	13.10
$B_0Zn_1Fe_1Cu_1$	9.28	9.67	48.07	49.03	528.78	631.97	12.33	13.17	12.27	13.17
$B_1Zn_0Fe_0Cu_0$	9.52	9.87	48.87	50.00	567.57	655.23	12.30	13.17	12.45	13.37
$B_1Zn_0Fe_0Cu_1$	9.23	9.67	48.10	49.00	545.45	652.98	12.15	13.00	12.85	13.50
$B_1Zn_0Fe_1Cu_0$	9.40	9.90	48.20	49.03	556.84	665.97	12.55	13.43	12.53	13.27
$B_1Zn_0Fe_1Cu_1$	9.32	9.67	48.36	49.43	530.66	638.41	12.15	13.00	12.44	13.47
$B_1Zn_1Fe_0Cu_0$	9.20	9.57	48.23	49.23	528.06	631.53	12.42	13.30	12.28	13.17
$B_1Zn_1Fe_0Cu_1$	9.48	9.90	48.97	49.67	567.96	659.31	12.45	13.00	12.07	13.10
$B_1Zn_1Fe_1Cu_0$	9.30	9.67	48.47	49.43	516.77	635.14	12.33	13.37	12.18	13.13
$B_1Zn_1Fe_1Cu_1$	9.25	9.83	47.83	49.47	543.23	651.52	12.85	13.47	12.90	13.77

S.Em.±	3.45	3.28	3.58	3.49	7.22	4.17	3.55	3.38	4.60	3.80
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interactions										
B_0	9.08	9.47	48.09	49.46	540.45	632.08	12.59	13.32	12.51	13.32
B_1	9.33	9.76	48.38	49.41	544.57	648.76	12.27	13.22	12.44	13.33
CD at 5%	NS	NS	NS	NS	NS	6.743	0.123	NS	NS	NS
Zn_0	9.15	9.54	48.44	49.78	541.44	633.69	12.43	13.20	12.58	13.37
Zn_1	9.26	9.69	48.03	49.09	543.58	647.16	12.43	13.33	12.36	13.29
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fe_0	9.15	9.54	48.12	79.33	545.90	638.32	12.47	13.29	12.56	13.36
Fe_1	9-26	9.68	48.35	49.55	539.12	642.53	12.40	13.24	12.38	13.30
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cu_0	9.16	9.55	48.25	49.59	543.36	638.48	12.61	13.41	12.42	13.23
Cu_1	9.26	9.68	48.21	49.28	541.66	642.37	12.25	13.13	12.52	13.43
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$B_0 \times Zn_0$	8.93	9.30	48.50	50.19	532.76	614.23	12.58	13.25	12.48	13.27
$B_0 \times Zn_1$	9.22	9.63	47.67	48.73	548.15	649.93	12.60	13.38	12.54	13.38
$B_1 \times Zn_0$	9.37	9.77	48.38	49.37	550.13	653.15	12.29	13.15	12.68	13.47
$B_1 \times Zn_1$	9.31	9.74	48.38	49.45	539.00	644.38	12.25	13.28	12.19	13.20
CD at 5%	NS	NS	NS	NS	NS	8.018	NS	NS	NS	NS
$B_0 \times Fe_0$	8.95	9.35	47.70	49.17	539.54	626.87	12.60	13.35	12.60	13.37
$B_0 \times Fe_1$	9.21	9.60	48.47	49.75	541.36	637.29	12.58	13.28	12.41	13.27
$B_1 \times Fe_0$	9.36	9.75	48.54	49.47	552.26	649.76	12.33	13.23	12.52	13.35
$B_1 \times Fe_1$	9.32	9.77	48.22	49.34	536.88	647.76	12.21	13.20	12.35	13.32
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$B_0 \times Cu_0$	8.96	9.35	48.07	49.75	544.42	629.98	12.82	13.50	12.43	13.25
$B_0 \times Cu_1$	9.35	9.75	48.44	49.42	542.31	646.97	12.40	13.32	12.41	13.21
$B_1 \times Cu_0$	9.20	9.58	48.11	49.17	536.49	634.18	12.37	13.13	12.58	13.39
$B_1 \times Cu_1$	9.32	9.77	48.32	49.39	546.82	650.56	12.14	13.12	12.47	13.46
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$Zn_0 \times Fe_0$	9.06	9.43	48.17	49.61	544.06	630.08	12.50	13.29	12.63	13.34
$Zn_0 \times Fe_1$	9.24	9.64	48.71	49.95	538.83	637.30	12.37	13.11	12.52	13.39
$Zn_1 \times Fe_0$	9.24	9.65	48.07	49.04	547.74	646.55	12.43	13.29	12.50	13.38
$Zn_1 \times Fe_1$	9.29	9.73	47.98	49.14	539.41	647.76	12.43	13.38	12.23	13.20
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$Zn_0 \times Cu_0$	9.15	9.56	48.59	50.24	548.04	634.09	12.52	13.28	12.53	13.25
$Zn_0 \times Cu_1$	9.15	9.52	48.29	49.32	534.85	633.29	12.34	13.12	12.63	13.48
$Zn_1 \times Cu_0$	9.16	9.54	47.92	48.93	538.69	642.86	12.69	13.53	12.32	13.21
$Zn_1 \times Cu_1$	9.37	9.83	48.13	49.25	548.46	651.45	12.17	13.13	12.41	13.37
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$Fe_0 \times Cu_0$	9.05	9.42	48.12	49.61	542.23	628.76	12.55	13.36	12.52	13.27
$Fe_0 \times Cu_1$	9.25	9.67	48.13	49.04	549.57	647.87	12.38	13.23	12.61	13.44
$Fe_1 \times Cu_0$	9.26	9.68	48.39	49.57	544.49	648.18	12.66	13.46	12.32	13.18
$Fe_1 \times Cu_1$	9.26	9.68	48.30	49.53	533.74	636.87	12.13	13.02	12.44	13.41
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$B_0 \times Zn_0 \times Fe_0$	8.75	9.10	47.87	49.72	531.61	606.06	12.77	13.50	12.39	13.12
$B_0 \times Zn_0 \times Fe_1$	9.12	9.50	49.13	50.67	533.91	622.40	12.38	13.00	12.56	13.42
$B_0 \times Zn_1 \times Fe_0$	9.14	9.57	47.53	48.63	547.48	647.68	12.43	13.20	12.82	13.62
$B_0 \times Zn_1 \times Fe_1$	9.30	9.70	47.82	48.83	548.82	652.19	12.77	13.57	12.26	13.13
$B_1 \times Zn_0 \times Fe_0$	9.38	9.77	48.48	49.50	556.51	654.10	12.23	13.08	12.88	13.57
$B_1 \times Zn_0 \times Fe_1$	9.36	9.78	48.28	49.23	543.75	652.19	12.35	13.22	12.49	13.37
$B_1 \times Zn_1 \times Fe_0$	9.34	9.73	48.60	49.45	548.01	645.42	12.43	13.38	12.18	13.13
$B_1 \times Zn_1 \times Fe_1$	9.27	9.75	48.15	49.45	530.00	643.33	12.07	13.18	12.21	13.27
CD at 5%	NS	NS	NS	NS	NS	NS	1.23	1.24	NS	NS
$B_0 \times Zn_0 \times Cu_0$	8.85	9.23	48.65	50.97	533.87	607.59	12.63	13.27	12.36	13.18
$B_0 \times Zn_0 \times Cu_1$	9.02	9.37	48.35	49.42	531.65	620.88	12.53	13.23	12.59	13.35
$B_0 \times Zn_1 \times Cu_0$	9.07	9.47	47.48	48.53	554.96	652.38	13.01	13.73	12.51	13.32
$B_0 \times Zn_1 \times Cu_1$	9.38	9.80	47.87	48.93	541.34	647.49	12.20	13.03	12.57	13.43
$B_1 \times Zn_0 \times Cu_0$	9.46	9.88	48.53	49.52	562.20	660.60	12.43	13.30	12.69	13.32
$B_1 \times Zn_0 \times Cu_1$	9.27	9.67	48.23	49.22	538.06	645.70	12.15	13.00	12.67	13.62
$B_1 \times Zn_1 \times Cu_0$	9.25	9.62	48.35	49.33	522.42	633.34	12.38	13.33	12.13	13.10
$B_1 \times Zn_1 \times Cu_1$	9.37	9.87	48.40	49.57	555.92	655.42	12.13	13.23	12.26	13.30
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$B_0 \times Fe_0 \times Cu_0$	8.74	9.12	47.68	49.60	536.65	614.15	12.75	13.48	12.48	13.28
$B_0 \times Fe_0 \times Cu_1$	9.15	9.55	47.72	48.75	542.44	639.60	12.46	13.22	12.73	13.45
$B_0 \times Fe_1 \times Cu_0$	9.18	9.58	48.45	49.90	552.18	645.82	12.88	13.52	12.39	13.22
$B_0 \times Fe_1 \times Cu_1$	9.24	9.62	48.50	49.60	530.55	628.77	12.27	13.05	12.43	13.33
$B_1 \times Fe_0 \times Cu_0$	9.36	9.72	48.55	49.62	547.81	643.38	12.36	13.23	12.57	13.27
$B_1 \times Fe_0 \times Cu_1$	9.36	9.78	48.53	49.33	556.70	656.15	12.30	13.23	12.48	13.43

$B_1 \times Fe_1 \times Cu_0$	9.35	9.78	48.33	49.23	536.80	650.56	12.44	13.40	12.25	13.15
$B_1 \times Fe_1 \times Cu_1$	9.28	9.75	48.10	49.45	536.95	644.97	11.98	13.00	12.45	13.48
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$Zn_0 \times Fe_0 \times Cu_0$	9.09	9.45	48.42	50.38	549.90	625.59	12.50	13.32	12.52	13.20
$Zn_0 \times Fe_0 \times Cu_1$	9.03	9.42	47.93	48.83	538.22	634.58	12.50	13.27	12.75	13.48
$Zn_0 \times Fe_1 \times Cu_0$	9.22	9.67	48.77	50.10	546.17	642.60	12.55	13.25	12.53	13.30
$Zn_0 \times Fe_1 \times Cu_1$	9.26	9.62	48.65	49.80	531.49	631.99	12.18	12.97	12.52	13.48
$Zn_1 \times Fe_0 \times Cu_0$	9.01	9.38	47.82	48.83	534.56	631.94	12.61	13.40	12.52	13.35
$Zn_1 \times Fe_0 \times Cu_1$	9.48	9.92	48.32	49.25	560.92	661.16	12.26	13.18	12.47	13.40
$Zn_1 \times Fe_1 \times Cu_0$	9.31	9.70	48.02	49.03	542.82	653.78	12.77	13.67	12.11	13.07
$Zn_1 \times Fe_1 \times Cu_1$	9.27	9.75	47.95	49.25	536.01	641.75	12.7	13.08	12.36	13.33
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
$B_0 \times Zn_0 \times Fe_0 \times Cu_0$	8.67	9.03	47.97	50.77	532.24	595.94	12.70	13.47	12.18	13.03
$B_1 \times Zn_0 \times Fe_0 \times Cu_0$	9.25	9.83	47.83	49.47	543.23	651.52	11.82	13.00	12.45	13.50
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of foliar spray of micronutrients on number of fruits and fruit yield per tree of mango fruit cv. Langa

Treatment	No. of fruits/tree		Yield (kg/tree)	
	2004-05	**2005-06**	**2004-05**	**2005-06**
$B_0Zn_0Fe_0Cu_0$	**381.33**	**690.00**	**95.33**	**172.50**
$B_0Zn_0Fe_0Cu_1$	401.67	750.00	100.42	187.50
$B_0Zn_0Fe_1Cu_0$	456.67	860.00	114.17	212.50
$B_0Zn_0Fe_1Cu_1$	626.67	1016.67	156.67	254.17
$B_0Zn_1Fe_0Cu_0$	557.00	1116.67	139.25	279.17
$B_0Zn_1Fe_0Cu_1$	738.33	1283.33	184.58	320.83
$B_0Zn_1Fe_1Cu_0$	672.67	1208.33	168.17	302.08
$B_0Zn_1Fe_1Cu_1$	838.00	1408.33	209.50	352.08
$B_1Zn_0Fe_0Cu_0$	945.00	1483.33	236.25	370.83
$B_1Zn_0Fe_0Cu_1$	1080.00	1791.67	270.00	447.92
$B_1Zn_0Fe_1Cu_0$	1131.67	1991.67	282.92	497.92
$B_1Zn_0Fe_1Cu_1$	1342.33	2066.67	335.58	516.67
$B_1Zn_1Fe_0Cu_0$	1238.33	2016.67	309.58	504.17
$B_1Zn_1Fe_0Cu_1$	1501.33	2333.33	375.33	583.33
$B_1Zn_1Fe_1Cu_0$	1411.33	2298.33	352.83	574.58
$B_1Zn_1Fe_1Cu_1$	1510.00	2501.67	377.50	625.42
S.Em.±	4.701	11.05	30.79	5.76
CD at 5%	NS	NS	NS	NS
Interactions				
B_0	584.04	1040.42	146.01	260.10
B_1	1270.00	2060.42	317.50	515.10
CD at 5%	8.614	17.081	11.023	6.164
Zn_0	795.67	1330.00	198.92	332.50
Zn_1	1058.38	1770.83	264.59	442.71
CD at 5%	8615	17.081	11.023	6.164
Fe_0	855.38	1433.13	213.84	358.28
Fe_1	998.67	1667.71	249.67	416.93
CD at 5%	8.615	17.081	NS	6.164
Cu_0	849.25	1456.88	212.31	364.22
Cu_1	1004.79	1643.96	251.20	410.99
CD at 5%	8.615	17.081	NS	6.164
$B_0 \times Zn_0$	466.58	826.67	116.65	206.67
$B_0 \times Zn_1$	701.50	1254.17	175.38	313.54
$B_1 \times Zn_0$	1124.75	1833.33	281.19	458.33
$B_1 \times Zn_1$	1415.25	2287.50	353.81	571.88
CD at 5%	10.244	NS	NS	NS
$B_0 \times Fe_0$	519.58	960.00	129.90	240.00
$B_0 \times Fe_1$	648.50	1120.83	162.13	280.21
$B_1 \times Fe_0$	1191.17	1906.25	297.79	476.56
$B_1 \times Fe_1$	1348.83	2214.58	337.21	553.65
CD at 5%	NS	NS	NS	7.330
$B_0 \times Cu_0$	516.92	966.25	129.23	241.56
$B_0 \times Cu_1$	1181.58	1947.50	295.40	486.88
$B_1 \times Cu_0$	651.17	1114.58	162.79	278.65
$B_1 \times Cu_1$	1358.42	2173.33	339.60	543.33
CD at 5%	NS	NS	NS	NS
$Zn_0 \times Fe_0$	702.00	1178.75	175.50	294.69
$Zn_0 \times Fe_1$	889.33	1481.25	222.33	370.31
$Zn_1 \times Fe_0$	1008.75	1687.50	252.19	421.88
$Zn_1 \times Fe_1$	1108.00	1854.17	277.00	463.54

CD at 5%	10.244	NS	NS	7.330
$Zn_0 \times Cu_0$	728.67	1253.75	182.17	313.44
$Zn_0 \times Cu_1$	862.67	1406.25	215.67	351.56
$Zn_1 \times Cu_0$	969.83	1660.00	242.46	415.00
$Zn_1 \times Cu_1$	1146.92	1881.67	286.73	470.42
CD at 5%	NS	NS	NS	NS
$Fe_0 \times Cu_0$	780.42	1326.67	195.10	331.67
$Fe_0 \times Cu_1$	930.33	1539.58	232.58	384.90
$Fe_1 \times Cu_0$	918.08	1587.08	229.52	396.77
$Fe_1 \times Cu_1$	1079.25	1748.33	269.81	437.08
CD at 5%	NS	NS	NS	NS
$B_0 \times Zn_0 \times Fe_0$	391.50	720.00	97.88	180.00
$B_0 \times Zn_0 \times Fe_1$	541.67	933.33	135.42	233.33
$B_0 \times Zn_1 \times Fe_0$	647.67	1200.00	161.92	300.00
$B_0 \times Zn_1 \times Fe_1$	755.33	1308.33	188.83	327.08
$B_1 \times Zn_0 \times Fe_0$	1012.50	1697.50	253.13	409.38
$B_1 \times Zn_0 \times Fe_1$	1237.00	2029.17	309.25	507.29
$B_1 \times Zn_1 \times Fe_0$	1369.83	2175.00	342.46	543.75
$B_1 \times Zn_1 \times Fe_1$	1460.67	2400.00	365.17	600.00
CD at 5%	NS	NS	NS	NS
$B_0 \times Zn_0 \times Cu_0$	419.00	770.00	104.75	192.50
$B_0 \times Zn_0 \times Cu_1$	514.17	883.33	128.54	220.83
$B_0 \times Zn_1 \times Cu_0$	614.83	1162.50	153.71	290.63
$B_0 \times Zn_1 \times Cu_1$	788.18	1345.83	197.04	336.46
$B_1 \times Zn_0 \times Cu_0$	1038.33	1737.50	259.58	434.38
$B_1 \times Zn_0 \times Cu_1$	1211.17	1929.17	302.79	482.29
$B_1 \times Zn_1 \times Cu_0$	1324.83	2157.50	331.21	539.38
$B_1 \times Zn_1 \times Cu_1$	1505.67	2417.50	376.42	604.38
CD at 5%	NS	NS	NS	NS
$B_0 \times Fe_0 \times Cu_0$	469.17	903.33	117.29	225.83
$B_0 \times Fe_0 \times Cu_1$	570.00	1016.67	142.50	254.17
$B_0 \times Fe_1 \times Cu_0$	564.67	1029.17	141.17	257.29
$B_0 \times Fe_1 \times Cu_1$	732.33	1212.50	183.08	303.13
$B_1 \times Fe_0 \times Cu_0$	1091.67	1750.00	272.92	437.50
$B_1 \times Fe_0 \times Cu_1$	1290.67	2062.50	322.67	515.63
$B_1 \times Fe_1 \times Cu_0$	1271.50	2145.00	317.88	536.25
$B_1 \times Fe_1 \times Cu_1$	1426.17	2284.17	356.54	571.04
CD at 5%	12.183	NS	NS	8.717
$Zn_0 \times Fe_0 \times Cu_0$	663.18	1086.67	165.79	271.67
$Zn_0 \times Fe_0 \times Cu_1$	740.83	1270.83	185.21	317.71
$Zn_0 \times Fe_1 \times Cu_0$	794.17	1420.83	198.54	355.21
$Zn_0 \times Fe_1 \times Cu_1$	984.50	1541.67	246.13	385.42
$Zn_1 \times Fe_0 \times Cu_0$	897.67	1566.67	224.42	391.67
$Zn_1 \times Fe_0 \times Cu_1$	1119.83	1808.33	279.96	452.08
$Zn_1 \times Fe_1 \times Cu_0$	1042.00	1753.33	260.50	438.33
$Zn_1 \times Fe_1 \times Cu_1$	1174.00	1955.00	293.50	188.75
CD at 5%	12.183	NS	NS	NS
$B_0 \times Zn_0 \times Fe_0 \times Cu_0$	381.33	690.00	95.33	172.50
$B_1 \times Zn_0 \times Fe_0 \times Cu_0$	1510.00	2501.67	377.50	625.42
CD at 5%	NS	NS	NS	NS

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