Oilseeds occupy a prestigious place in Indian agriculture due to their vital role in the sustainable economy of the country. Vegetable oil (edible) plays a significant role in human nutrition. As a high energy component of food, edible oil is important for meeting the calorific requirements of human beings. Indian mustard is one of the most important winter oil seed crop. The production of mustard is not fully exploited due to the lack of proper information on its nutritional requirements. Sulphur deficiency in soils is on the increase with intensification of agriculture. The continuous use of major plant nutrients such as N P and K through chemical fertilizers has resulted in the depletion of soils of their secondary and micronutrient reserves. There are instances where application of adequate amounts of N, P and K failed to give optimum yields until the deficiency of sulphur was corrected. The sulphur fertility status of soils in oilseed growing regions is poor and widespread sulphur deficiency has been observed in crops and soils in 120 district of India irrespective of soil texture and cropping pattern.(Tandon1991). It has been reported that removal of sulphur per tonne of grain is 3 kg in cereals against 12 kg in oil seeds (Tandon, 1995).
Aulakh et al. (1985) also reported that the quantity of S removal from soil was highest by oilseed crops followed by pulses.

In India, Rajasthan ranks first both in area and production and Gujarat state has the highest productivity of rapeseed and mustard. In Uttar Pradesh, rapeseed and mustard in general is grown on 6.58 lakh ha area with production of 0.76 mt and productivity of 1155 kg ha$^{-1}$ [2]. Indian mustard markedly responded to sulphur fertilization [Jaggi and Sharma, 1999]. In oilseeds, sulphur plays a vital role in the development of seed and improving the quality [Jaggi, 1994]. Sulphur improves the quality of mustard by increasing the oil contents, protein content and several fatty acids and also helps in chlorophyll formation and also encourages vegetative growth [Kumar et al., 2006]. It also helps in the reduction-oxidation reactions in the respiration. The importance of micronutrients application in increasing crop production has been recognized in India, but the work has been mostly confined to fruits and vegetable crops only. Zinc plays an important role in plant system for the proper growth and development. Zinc is an important constituent of several enzymes which regulates various metabolic processes in the plants and also influences the formation of several growth hormones like IAA in plants. Zinc stimulates the pod setting, seed formation and oil synthesis in the seeds of mustard and it increases the biological seed and stover yield of mustard [Singh and
Singh, 2003]. The information regarding the application of sulphur and zinc in Indian mustard is very meager and fragmentary particularly for eastern Uttar Pradesh.

The Zn and S availability in the soils of oilseeds especially mustard growing areas of Uttar Pradesh is very poor as the growers apply more and more N. P. and K in their crops like wheat, Rice, sugarcane potato and vegetables but the use of micronutrients is very limited resulting deficit of these nutrients in soils. as per soil status reports and fertility standards of U.P. soils The soils showed very poor status of micronutrients especially S, Zn and Boron. Tewari and Dwivedi (1994) reported 0.08-9.76 ppm DTPA Zn in soils of U.P. Widespread deficiency of Zn was noticed in all the districts, The magnitude being larger (50%) in soils Farukhabad, Mainpuri and Agra. The soils of other districts exhibited Zn deficiency in the range of 38 to 47% except Lalitpur where the deficiency was of lowest order (29%).

Keeping the above facts in view an attempt has been made to study the “Effect of sulphur and zinc levels on yield and quality of Indian mustard [Brassica juncea (L.) Czem & Coss.]” is taken.

Analysis of variance of experimental data analysis as presented in table 2 and 2a) revealed highly significant differences for all the characters in respect to both the treatments as evident from the table indicating sufficient variability for various levels of both Zn and S applications. On the
other hand the interaction effects between Zn and S was non significant for all the characters.

The individual effect of various levels of S and Zn is presented in tables 3 to 16a respectively and character wise impact of both the nutrients are described here in the light of literature available on the topic in general and crop as special as under:

**Effect on days to flowering**

The effect of various level of Zn and S on days to flowering based on both the years of results are presented in table 3 and 3a respectively which revealed that during first year of experiment maximum days to flowering was noted when sulphur was given at the rate of S4 i.e. 45.76 days while it was minimum with S1treatment i.e. 42.95 days in clearly indicated that higher dose of sulphur helps the crop in delayed flowering. The effect of Zn alone showed that Zn4 level obtained very late flowering (45.76 days) while Zn1 level of Zinc application showed early flowering (42.94 days).

During second year of trial (table 3a) revealed that maximum days to flowering was noted in S4 level of S nutrition (45.95 days) and minimum with S1 level of S (43.80 days). The effect of Zinc level showed that maximum delayed flowering was given by Zn 4 level of Zinc (46.44 days) and minimum with Zn 1 (43.79 days). The interaction between S and Zn levels on days to flowering were non significant during both the years.
Omidian et al. (2012) also noted delayed flowering in his research with ZnSO₄. The interaction effect of S and Zn was non significant during both the years.

**Effect on days to maturity**

The effect of various level of Zn and S on days to maturity based on both the years of results are presented in table 4 and 4a respectively which revealed that during first year of experiment maximum days to maturity was noted when sulphur was given at the rate of S4 i.e. 132.64 days while it was minimum with S1 treatment i.e. 129.06 days in clearly indicated that higher dose of sulphur helps the crop in delayed in maturity. The effect of Zn alone showed that Zn4 level provided very late maturity (132.54 days) while Zn1 level of Zinc application showed early maturity (129.50 days).

During second year of trial (table 4a) revealed that maximum days to maturity was noted in S4 level of S nutrition (133.68 days) and minimum with S1 level of S (129.86 days). The effect of Zinc level showed that maximum days to maturity was given by Zn 4 level of Zinc (132.70 days) and minimum with Zn 1 (130.32 days) respectively. The findings of Omidian et al. (2012) was also in favour of these results. The interaction between S and Zn levels on days to maturity were non significant during both the years.
Effect on no. of siliqua per plant

The effect of various level of Zn and S on no. of siliqua per plant based on both the years of results are presented in table 5 and 5a respectively which revealed that during first year of experiment maximum no. of siliqua per plant was noted when sulphur was given at the rate of S4 i.e. 337.36 while it was minimum with S1 treatment i.e. 307.01 it clearly indicated that higher dose of sulphur helps the crop to bear maximum no. of siliqua per plant. The effect of Zn alone showed that Zn4 level provided maximum no. of siliqua per plant (338.96) while Zn1 level of Zinc application showed minimum no. of siliqua per plant (312.34).

During second year of trial (table 5a) revealed that maximum no. of siliqua per plant was noted in S4 level of S nutrition (344.85) and minimum with S1 level of S (313.79). The effect of Zinc level showed that maximum number of siliqua was produced by Zn 4 level of Zinc (344.27) and minimum with Zn 1(319.79) respectively.

The interaction between S and Zn levels on number of siliqua were non significant during both the years.

Singh et al.(2012) noted that application of 40 kg S/ha and 6 kg Zn/ha improved growth parameters like plant height, number of branches per plant and yield components viz., number of siliquae per plant, seed per siliqua, seed yield and stover yield as compared to other treatments. Oil content in
seed increased significantly up to application of 80 kg S/ha. Protein content significantly increased up to 40 kg S/ha and 6 kg Zn/ha. While Singh et al. (2016) reported that effect of sulphur on Harvest index, 1000 grain weight (g), nitrogen and protein content were found non-significant. Seed yield, Stover yield and sulphur content in seed and stover was significantly increased with increasing dose of sulphur up to 60 Kg ha-1 superior over control, 15 and 30 Kg S ha-1 and at par with 45 Kg S ha-1

Effect on biomass yield (q/ha)

The mean effect of various levels of Zn and S on plant biomass yield per hectare based on both the years of experiments is presented in table 6 and 6a respectively which revealed that during first year of experiment maximum plant biomass was produced with S4 level of sulphur. The total biomass yield with this treatment was 77.56 q/ha while it was minimum with S1 treatment i.e. 78.69q/ha. It is also evident from the table that the biomass yield increased with the increase in S levels and clearly indicated that higher dose of sulphur helps the crop to produce maximum biomass. The effect of Zn alone showed that Zn4 level provided maximum biomass yield (q/ha) i.e. 77.95 q/ha while Zn1 level of Zinc application showed minimum biomass yield (q/ha) i.e. 71.70 q/ha. Tripathi et al. (2011), Stanis et al. (2012), Olama et al. (2014) and Trivedi et al. (2013) were in view to the results obtained in present research work. While Singh et al. (2016) found that
Stover yield and sulphur content in seed and stover was significantly increased with increasing dose of sulphur up to 60 Kg ha\(^{-1}\) superior over control, 15 and 30 Kg S ha\(^{-1}\)and at par with 45 Kg S ha\(^{-1}\)

During second year of trial (table 6a) revealed that maximum biomass yield (q/ha) was noted in S4 level of S nutrition (90.55) and minimum with S1 level of S (78.69 q/ha). The effect of Zinc level showed that maximum biomass yield (q/ha) was produced by Zn 4 level of Zinc (90.55 q/ha) and minimum with Zn 1(77.85 q/ha) respectively. Jankowski et al (2014), Jankowski et al (2014) and Yadav and Sharma (2002) also reported similar results

The interaction between S and Zn levels on biomass yield (q/ha) were non significant during both the years.

**Effect on grain yield (q/ha)**

The mean effect of various levels of Zn and S on grain yield per hectare based on both the years of experiments is presented in table 7 and 7a respectively which revealed that during first year of experiment significantly maximum grain yield per hectare was produced with S4 level of sulphur. The total grain yield per hectare with this treatment was 15.74 q/ha while it was minimum with S1 treatment i.e. 14.32 q/ha. It is also evident from the table that the grain yield per hectare increased with the increase in S levels and clearly indicated that higher dose of sulphur helps the crop to produce
maximum grain yield per hectare. The effect of Zn alone showed that Zn4 level produced maximum grain yield per hectare (q/ha) i.e. 18.53 q/ha while Zn1 level of Zinc application showed minimum grain yield per hectare i.e. 14.56 q/ha. Omidian et al. (2012) found that foliar application of zinc sulphate at stem elongation and flowering stages increased grain yield (by 11% and 17%, respectively).

During second year of trial (table 7a) revealed that maximum grain yield per hectare was noted in S4 level of S nutrition (18.36 q/ha) and minimum with S1 level of S (15.98 q/ha). The effect of Zinc level showed that maximum grain yield per hectare was produced by Zn 4 level of Zinc (18.53 q/ha) and minimum with Zn 1(15.80 q/ha) respectively. Ray et al. (2015), Jaga (2013), Parmar and Parmar(2012) and Singh and Sarkar (2013) and Yadav and Sharma (2002) were in vicinity with these results

The interaction between S and Zn levels on grain yield per hectare were non significant during both the years.

Jankowski et al (2014). Reported that Sulfur application has a significant effect on the yield of oil bearing plants of the family Brassicaceae, especially when the sulfur content of soil is low. Sulfur fertilization also affects the value of plant raw materials, reflected by the concentrations of mineral and biologically active compounds in biomass.
While Hafeez et al. (2013) reported that Sulphur (S) nutrition is very important for harvesting potential seed and oil yield of rapeseed.

On the other hand Jat and Mehra (2007) reported that application of 40 Kg S and 5Kg Zn /ha significantly increase the grain and stover yield.

**Effect on Stover yield (q/ha)**

The mean effect of various levels of Zn and S on Stover yield per hectare based on both the years of experiments is presented in table 8 and 8a respectively which revealed that during first year of experiment significantly maximum Stover yield per hectare was produced with S4 level of sulphur. The total Stover yield per hectare with this treatment was 56.23 q/ha while it was minimum with S1 treatment i.e. 61.83 q/ha. It is also evident from the table that the Stover yield per hectare increased with the increase in S levels and clearly indicated that higher dose of sulphur helps the crop to produce maximum Stover yield per hectare. The effect of Zn alone showed that Zn 4 level produced maximum Stover yield per hectare i.e. 62.14 q/ha while Zn1 level of Zinc application showed minimum grain yield per hectare i.e. 57.14 q/ha.

During second year of trial (table 8a) revealed that maximum Stover yield per hectare was noted in S4 level of S nutrition (72.19 q/ha) and minimum with S1 level of S (62.72 q/ha). The effect of Zinc level showed
that maximum stover yield per hectare was produced by Zn 4 level of Zinc (72.83 q/ha) and minimum with Zn 1 (62.04 q/ha) respectively.

The interaction between S and Zn levels on Stover yield per hectare were non significant during both the years.

Kumar et al. (2012) while working with four sources of sulphur (ammonium sulphate, gypsum, single super phosphate and pyrite) on the yield, quality and nutrient uptake of mustard (Brassica juncea) and noted that Seed and straw yields, oil content and protein content increased significantly with increasing level of sulphur up to highest level of 60 kg S/ha. Application of 20, 40 and 60 kg S/ha increased the seed yield over the control by 13.95, 28.11 and 28.47%. While, the difference between 40 and 60 kg S/ha was found at par. Application of 60 Kg S/ha significantly increased the N, P, K and S uptake of seed and also S use efficiency and S uptake efficiency over other treatment of S.

Significantly influenced the plant height, number of branches plant-1, leaf area index, number of siliqua plant-1, length of siliqua, number of seeds siliqua-1 and dry matter accumulation plant-1, which was at par with 30 and 45 Kg S ha-1 and significantly superior over rest levels of sulphur. whereas, effect of sulphur on Harvest index, 1000 grain weight (g), nitrogen and protein content were found non-significant. Seed yield, Stover yield and sulphur content in seed and stover was significantly increased with
increasing dose of sulphur up to 60 Kg ha-1 superior over control, 15 and 30 Kg S ha-1and at par with 45 Kg S ha-1. NDR-8501 with 45 kg S ha-1 gave highest benefit cost ratio (1.77) against lowest benefit cost ratio obtained at 0 kg S ha-1 with Vardan. Thus it may be concluded that NDR-8501 with 45 kg S ha-1 proved as the most suitable practice to get higher yield and quality of mustard as reported by Singh et al. (2016), Dubey et al. (2013), Gallejones et al. (2012) and Singh et al. (2016)

Effect on test weight (g)

The mean effect of various levels of Zn and S on test weight based on both the years of experiments is presented in table 9 and 9a respectively which revealed that during first year of experiment significantly maximum test weight of seeds was gained with S4 level of sulphur. The total mean test weight with this treatment was 4.453g while it was minimum with S1 treatment i.e. 4.052g. It is also evident from the table that the test weight increased with the increase in S levels and clearly indicated that higher dose of sulphur helps the crop to produce heavier grains resulting higher yield. The effect of Zn alone showed that Zn 4 level produced maximum test weight i.e. 4.475g while Zn1 level of Zinc application showed minimum test weight i.e. 4.120g.

During second year of trial (table 8a) revealed that maximum test weight was noted in S4 level of S nutrition (4.492 g) and minimum with S1
level of S (4.095 g). The effect of Zinc level showed that maximum test weight was produced by Zn 4 level of Zinc (4.505 g) and minimum with Zn 1 (4.160 g) respectively.

The interaction between S and Zn levels on test weight were non significant during both the years.

**Effect on oil content %**.

The mean effect of various levels of Zn and S on oil content in % based on both the years of experiments is presented in table 10 and 10a respectively which revealed that during first year of experiment significantly maximum oil content in seeds was gained with S4 level of sulphur. The total mean oil content with this treatment was 40.45% while it was lowest with S1 treatment i.e. 38.16%. It is also evident from the table that the oil content increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to produce more oil resulting higher oil yield. The effect of Zn alone showed that Zn 4 level produced maximum oil content i.e. 39.96% while Zn1 level of Zinc application showed lowest oil content in seeds i.e. 38.40%. **Yadav and Sharma (2002)** were in lieu of above results.

During second year of trial (table 10a) revealed that maximum oil content was synthesized in S4 level of S nutrition (40.49%) and minimum with S1 level of S (38.46%). The effect of Zinc level showed that maximum
oil content was synthesized by Zn 4 level of Zinc (40.24%) and minimum with Zn 1(38.46%) respectively. On an average, oil content increased significantly with the application of sulphur it may be attributed to increase in glycosides. Kumar et al. (2006) reported similar results. These results are in accordance with the earlier reports of Tewari et al. (2015) in case of Sulphur doses. While Dubey et al. (2013) reported that application of 60 kg S ha−1 and 10 kg Zn ha−1, produced significantly higher plant, primary and secondary branches plant−1, number of leaves plant−1, days taken to flowering, days taken to maturity, number of siliqua plant−1, length of siliqua, and number of seeds siliqua−1, harvest index and oil content. However, dry matter accumulation plant−1, 1000 -grain weight (g), biological yield, seed yield, stover yield and protein content significantly increased with increasing dose of sulphur up to 40 kg and zinc 7.5 kg ha−1.

The interaction between S and Zn levels on oil content were non significant during both the years.

**Effect on Iodine value**

The Iodine value of any oil is an indicator of fast drying of that oil and in case of edible oils it has no any significant effect on oil quality.

However in present study the Iodine value was considered as the quality trait only. The mean effect of various levels of Zn and S on Iodine value based on both the years of experiments is presented in table 11 and
11a respectively which revealed that during first year of experiment significantly maximum Iodine value in seeds was gained with S4 level of sulphur. The total mean Iodine value with this treatment was 140.65 while it was lowest with S1 treatment i.e. 138.54. It is also evident from the table that the level of Iodine value increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to produce more Iodine value. The effect of Zn alone showed that Zn 4 level produced maximum Iodine value i.e. 140.80 while Zn1 level of Zinc application showed lowest Iodine value in oil i. e. 138.25.

During second year of trial (table 11a) revealed that maximum Iodine value was synthesized in S4 level of S nutrition (140.74) and minimum with S1 level of S (138.72). The effect of Zinc level showed that maximum Iodine value was synthesized by Zn 4 level of Zinc (140.995) and minimum with Zn 1(138.315) respectively.

The interaction between S and Zn levels on Iodine value was non significant during both the years.

**Effect on Protein content %**

The mean effect of various levels of Zn and S on protein content based on both the years of experiments is presented in table 12 and 12a respectively which revealed that during first year of experiment significantly maximum protein content in seeds was gained with S4 level of sulphur. The
total mean protein content with this treatment was 18.96% while it was lowest with S1 treatment i.e. 17.588%. It is also evident from the table that the level of protein content synthesis increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to produce more protein content. The effect of Zn alone showed that Zn 4 level produced maximum protein content 18.94% while Zn1 level of Zinc application showed lowest protein content (17.77%).

During second year of trial (table 11a) revealed that maximum protein content was synthesized in S4 level of S nutrition (19.03%) and minimum with S1 level of S (17.66%). The effect of Zinc level showed that maximum protein content was synthesized by Zn 4 level of Zinc (19.01%) and minimum with Zn 1(17.83%) respectively. Kumar et al. (2012) while working with four sources of sulphur (ammonium sulphate, gypsum, single super phosphate and pyrite) on the yield, quality and nutrient uptake of mustard (Brassica juncea) and noted that Seed and straw yields, oil content and protein content increased significantly with increasing level of sulphur up to highest level of 60 kg S/ha. Application of 20, 40 and 60 kg S/ha increased the seed yield over the control by 13.95, 28.11 and 28.47%. While, the difference between 40 and 60 kg S/ha was found at par. Application of 60 Kg S/ha significantly increased the N, P, K and S uptake of seed and also S use efficiency and S uptake efficiency over other treatment of S.
Enhancement in oil and protein contents were increased by application of zinc sulphate as also reported by Omidian et al. (2012) and Yadav and Sharma (2002).

The interaction between S and Zn levels on protein content was non significant during both the years.

Singh et al.(2012) noted that application of 40 kg S/ha and 6 kg Zn/ha improved growth parameters like plant height, number of branches per plant and yield components viz., number of siliquae per plant, seed per siliqua, seed yield and stover yield as compared to other treatments. Oil content in seed increased significantly up to application of 80 kg S/ha. Protein content significantly increased up to 40 kg S/ha and 6 kg Zn/ha. While Verma et al. (2012) reported that application of 10 kg Zn/ha produced maximum seed yield, net return, B:C ratio, oil yield, protein yield and nutrients uptake of mustard. The application of 1.0 kg B/ha significantly increased seed yield, economics, oil yield, protein yield and nutrients uptake (kg/ha) of mustard over control and 0.5 kg B/ha. Yadav and Sharma (2002) also reported similar results.

Effect on Zn content in seeds

The mean effect of various levels of Zn and S on Zn content in seeds based on both the years of experiments is presented in table 13 and 13a respectively which revealed that during first year of experiment significantly
maximum Zn content in seeds was gained with S4 level of sulphur. The mean Zn content in seeds with this treatment was 0.062% while it was lowest with S1 treatment i.e. 0.045%. It is also evident from the table that the level of Zn content in seeds increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to more accumulation of Zn content in seeds. The effect of Zn alone showed that Zn 4 level produced maximum Zn content in seeds i.e. 0.068% while Zn1 level of Zinc application showed lowest Zn content in seeds i.e.0.042%.

During second year of trial (table 13a) revealed that maximum Zn content in seeds was synthesized in S4 level of S nutrition (0.075%) and minimum with S1 level of S (0.055%). The effect of Zinc level showed that maximum Zn content in seeds was synthesized by Zn 4 level of Zinc (0.083%) and minimum with Zn 1(0.053%) respectively.

The interaction between S and Zn levels on protein content was non significant during both the years.

**Tripathi et al. (2011)** reported that the incensement in yield and quality attributes along with uptake is possible with higher doses of S and Zn application.

**Effect on S content in seeds**

The mean effect of various levels of Zn and S on S content in seeds based on both the years of experiments is presented in table 14 and 14a
respectively which revealed that during first year of experiment significantly maximum S content in seeds was gained with S4 level of sulphur. The mean S content in seeds with this treatment was 0.090 % while it was lowest with S1 treatment i.e. 0.057%. It is also evident from the table that the level of S content in seeds increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to more accumulation of S content in seeds. The effect of Zn alone showed that Zn 4 level produced maximum S content in seeds i.e. 0.103% while Zn1 level of Zinc application showed lowest S content in seeds i.e.0.055%

During second year of trial also (table 14a) revealed that maximum S content in seeds was synthesized in S4 level of S nutrition (0.100%) and minimum with S1 level of S (0.070%). The effect of Zinc level showed that maximum S content in seeds was synthesized by Zn 4 level of Zinc (0.110%) and minimum with Zn 1level (0.065%) respectively. Tripathi et al. (2011), Singh and Sarkar (2013), Neha et al. (2014), Olama et al. (2014) and Yadav and Sharma (2002).

The interaction between S and Zn levels on S content was non significant during both the years.

**Effect on Zn uptake by seeds**

The mean effect of various levels of Zn and S on Zn uptake in seeds based on both the years of experiments is presented in table 15 and 15a
respectively which revealed that during first year of experiment significantly maximum Zn uptake in seeds was gained with S4 level of sulphur. The mean Zn uptake in seeds with this treatment was 0.986 % while it was lowest with S1 treatment i.e. 0.652%. It is also evident from the table that the level of Zn uptake in seeds increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to more accumulation of Zn uptake in seeds. The effect of Zn alone showed that Zn 4 level enhanced maximum Zn uptake in seeds i.e. 1.109 % while Zn1 level of Zinc application showed lowest Zn uptake in seeds i.e.0.625%. It might be attributed due to more up take of Zn and s by the seed as also reported by Jat and Mehra (2007).

During second year of trial also (table 14a) revealed that maximum Zn uptake in seeds was synthesized in S4 level of S nutrition (1.39 %) and minimum with S1 level of S (0.89%). The effect of Zinc level showed that maximum Zn uptake in seeds was synthesized by Zn 4 level of Zinc (1.536 %) and minimum with Zn 1level (0.84 %) respectively. Nanjunandan et al. (2012) while partitioning the Sulphur uptake in stem, root, leaf and siliqua in Indian mustard found vast genetic variability for sulphur assimilation and partitioning across the genotypes. Sulphur concentration in siliqua was highest and followed by leaves, stem and root. The sulphur partitioning was influenced by increasing S levels from 0 to 60 kg S ha-1 resulting in more S
diversion to the vegetative parts like stem, root and leaves than to the reproductive parts like siliqua. Three crosses \{RH 30— RH (OE) 103, RH 0270— F1 and RH 30— HO 1\} were found to mobilize highest amount of sulphur from source to sink, and can be exploited for partitioning more sulphur into the reproductive parts (siliqua) which, in turn, may result in better oil in terms of both quantity and quality. these results are in accordance with the reports of Yadav and Sharma (2002).

The interaction between S and Zn levels on Zn uptake in seeds was non significant during both the years.

**Effect on S uptake by seeds**

The mean effect of various levels of Zn and S on S uptake in seeds based on both the years of experiments is presented in table 16 and 16a respectively which revealed that during first year of experiment significantly maximum S uptake in seeds was gained with S4 level of sulphur. The mean S uptake in seeds with this treatment was 1.242 % while it was lowest with S1 treatment i.e. 0.833%. It is also evident from the table that the level of S uptake in seeds increased with the increase in S levels and clearly indicated that higher dose of sulphur helps in the crop to more accumulation of S uptake in seeds. The effect of Zn alone showed that Zn 4 level enhanced maximum S uptake in seeds i.e. 0.1.628 % while Zn1 level of Zinc application showed lowest S uptake in seeds i.e. 0.809 %
During second year of trial also (table 16a) revealed that maximum S uptake in seeds was synthesized in S4 level of S nutrition (1.853 %) and minimum with S1 level of S (1.133%). The effect of Zinc level showed that maximum S uptake in seeds was synthesized by Zn 4 level of Zinc (2.049 %) and minimum with Zn 1level (1.036 %) respectively.

The interaction between S and Zn levels on S uptake in seeds was non significant during both the years.

Increase in S uptake by the application of sulphur has also been observed by Jaggi and Sharma (1999) and Saraswat and Singh (2007) Singh and Singh (2003) and Yadav and Sharma (2002).

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