Influence of weed management on growth and productivity of maize (*Zea mays* L.) and residual effect on succeeding wheat (*Triticum aestivum* L.)

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ABSTRACT : To study different weed control measures in maize and residual effect in succeeding wheat crop, experiment consisted of ten treatments *viz*., Atrazine @ 1.0 kg ai/ha + 1 HW (hand weeding) (T_1), Metribuzine @ 0.25 kg ai/ha + 1 HW (T_2), Alachlor @ 0.5 kg ai/ha+ Atrazine @ 0.5 kg ai/ha + 1 HW (T_3), Glyphosate @ 1.0 kg *a.i.*/ha followed by Atrazine @ 375 g *a.i.*/ha + Alachlor @ 0.5 kg *a.i.*/ha, + 1 HW (T_4), Glyphosate @ 1.0 kg *a.i.*/ha + 2,4D EE @ 0.1 kg *a.i.*/ha, (T_5), Atrazine @ 0.5 kg *a.i.*/ha + 2,4D EE @ 0.4 kg *a.i.*/ha (T_6), maize + cowpea (T_7), maize + mungbean (T_8), weedy check (T_9) and weed free (T_{10}) was conducted in RBD with three replications at GBPUA&T, Pantnagar during 2010-11. Grain yield was significantly higher (5,740 kg/ha) under weed free treatment but remained at par with T_1, T_4, T_5, T_6 and T_7. Maize + cowpea showed the highest weed control efficiency (82.8%) whereas the lowest value was in Metribuzine @ 0.25 kg ai/ha + 1 HW. Maize + cowpea system also had maximum net return (Rs. 62,789/ha). None of the treatments carried residual left over effect in succeeding wheat crop.

Key words: Maize, herbicide, weed, wheat, yield

Among the various reasons for the low productivity of maize in India heavy weed infestation is considered to be one of the major ones. Weeds compete with the crop for nutrients, moisture, light and space. Thus damage caused by weeds is irreversible. Severe yield loss in *kharif* maize occurs due to heavy weed infestation owing to slow initial growth of crop, wider row spacing, heavy use of fertilizers *etc*.. Maize being rainy season crop is infested by a wide range of weed flora. Timely and effective weed control is pre-requisite to obtain higher productivity of maize for which chemical method is a good option. In general, many pre-emergence herbicides are used to control the diverse flora of weeds but they differ in their efficacy. There are very few herbicide options available for weed control in maize in India. Currently, herbicides used for control of weeds include pre-emergence application of atrazine, pendimethalin, alachlor and post-emergent application of 2, 4-D. Most of these herbicides provide only a narrow spectrum weed control in maize (Patel *et al.,* 2006). The combination of different herbicides may reduce weed growth effectively. The combined use of two or more herbicides seems to be essential for effective control of all the weeds (Sharma and Pankaj, 2013). Use of pre and post-emergence application of herbicides would make chemical control of early and late emerging weeds, respectively. Injudicious use of herbicides results in residual toxic effect and pollutes the environment. Hand weeding is a good option over chemical weed control but it is labour intensive, time consuming and expensive. Many times timely operations are not feasible due to non availability of labourers, continuous rains and odd soil conditions. Some legumes such as soybean, urdbean, mungbean cowpea *etc*. may be intercropped successfully in maize and have smothering effect on weeds. Many researchers (Buchler *et al.*, 2001 and Ghosheh *et al*., 2005) clearly demonstrated beneficial effects of maize plus legume intercrops on weed suppression and crop growth.

Maize-wheat cropping system is widely adopted in India. The herbicide used in maize crop may have residual toxic effect in succeeding wheat crop. Persistence of applied herbicides in the field and its carry over effect on succeeding crop depend much on nature, dose and time of herbicide application, crop duration, nature of following crop and soil type. Hence, it becomes essential to find out suitable herbicide in maize so that succeeding wheat crop is not adversely affected. Therefore, the present investigation was under taken to find out the best weed management strategies for maize in maize wheat cropping system and to study their left over effects on succeeding wheat crop.

MATERIALS AND METHODS

The experiment was carried out during *Kharif* and *Rabi* 2010-11 with maize-wheat sequence on fixed plots at the N.E. Borlaug Crop Research Centre of G.B Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) with the objective to find out the best weed management strategies for maize in maize wheat cropping system in *Tarai* region of Uttarakhand. Pantnagar is situated at 29^0 N latitude, 79.5^0 E longitude and an altitude of 243.83 m above mean sea level in the foot hills of Himalayas. The climate of the region is broadly humid subtropical with cool winter and hot dry summer. The experimental site was sandy loam in texture having neutral reaction (pH 6.97), rich in organic carbon (1.18%), low in available nitrogen (212 kg/ha) and medium in available P (18.14 kg/ha) and K (258.23 kg/ha).

The experiment consisted of ten treatments *viz*., T_1 Atrazine @1.0 kg ai/ha (PE) + 1 HW (hand weeding), T_2 Metribuzine @ 0.25 kg ai/ha (PE) + 1 HW, T_3 Alachlor@ 0.5 kg ai/ha(PE) + Atrazine @ 0.5 kg ai/ha (PE) + 1 HW, T_4 Glyphosate @ 1.0 kg *a.i.*/ha pre plant followed by Atrazine@ 375 g *a.i.*/ha+ Alachlor @ 0.5 kg *a.i.*/ha, PE+ 1 HW,T_5 Glyphosate @ 1.0 kg *a.i.*/ha, pre plant + 2,4D EE @ 0.1 kg *a.i.*/ha, POE ,T_6 Atrazine@ 0.5 kg *a.i.*/ha, PE + 2,4D EE @ 0.4 kg *a.i.*/ha, POE,T_7 Maize + Cowpea, T_8 Maize + Mungbean, T_9 Weedy check and T_{10} Weed free was laid out in RBD with three replications. Pre-emergence herbicides were applied just after sowing of maize crop by "Knapsack" hand sprayer with flat fan nozzle and post-emergence application of 2, 4- D EE was made 23 DAS by using spray volume of 500 l/ha. Protected hood was used to spray 2, 4-D EE in between the rows to prevent injury to maize plants. Two rows of cowpea ('Pant lobia-1') in treatment T_7 and two rows of mungbean ('Pant mung 5') in T_8 were sown between two rows of maize as cover crop. The weedy check was kept undisturbed for the entire cropping period in both the crops. One hand weeding in treatment T_1, T_2, T_3 and T_4 was done 25 days after sowing. The variety 'Pant Sankul Makka 3' was sown at spacing of 60 × 25 cm. The crop was grown under recommended agronomic practices with the application of 120 kg N, 60 kg P_2O_5, 40 kg K_2O / ha. One third of N and full P_2O_5 and K_2O were applied as basal. Remaining N was top dressed in two equal splits first at knee high and second at tasseling stage. Sources of nitrogen, phosphorus and potassium were urea, single super phosphate and muriate of potash, respectively. Crop was sown on 30 June and harvested on 30 September, 2010. The gross and net plot size were 9.6 and 4.2 m^2, respectively. The plant sample of randomly selected five plants was taken from each net plot for analysis of growth and yield parameters. In sequence wheat (cv 'PBW 343') was raised at 20 cm row spacing with recommended agronomic practices to asses the residual effect of weed management treatment in preceding maize crop. Wheat was sown on 15 November, 2010 and harvested on 12 April, 2011 and was fertilized with 120 kg N, 60 kg P_2O_5, 40 kg K_2O / ha. One third of N and full P_2O_5 and K_2O were applied as basal. Remaining N was top dressed in two equal splits at 30 and 60 DAS. Data pertaining to weed population were recorded at 60 DAS in maize using 50 cm × 50 cm size quadrate. The data obtained from various observations were statistically analyzed as per procedure of RBD design (Gomez and Gomez, 1984). The results were interpreted on the basis of F-test and critical difference at 5 per cent for calculating the significant difference between two treatment means.

RESULTS AND DISCUSSION

Maize

The growth parameters *viz*., number of plants and plant height affected significantly due to weed control treatments (Table 1).The plant stand varied from 69,444 to 82,407 plants/ha with significantly maximum plant stand under weed free and Atrazine@ 0.5 kg *a.i.*/ha, PE + 2,4-D EE @ 0.4 kg *a.i.*/ha, POE that remained non-significant with T_1 and T_4 treatments. Significantly lowest plant population was obtained in weedy condition. The variations in weed population under different treatment might result differences in plant population. The uninterrupted growth of weed in weedy check caused lowest population of maize. The trailering habit of cowpea and mungbean resulted in to lower plant population of maize in their respective intercropping treatments. Significantly tallest plants were observed under Atrazine@ 0.5 kg *a.i.*/ha, PE + 2,4-D EE @ 0.4 kg *a.i.*/ha, POE that was at par with all the treatments except Metribuzine @ 0.25 kg *a.i.*/ha, PE+ 1 HW and weedy condition. The high weed competition for inputs *viz*., space, nutrient, water, light, *etc*. in T_2 and T_9 might result shorter plants under these treatments. Phenology of maize crop did not vary due to weed control treatments as non significant differences were noted in days required to reach 50% tasseling and 50% silking however, the earliest silking was observed under weed free treatments.

The treatment effect was more pronounced on yield attributes (Table 1 and 2). Cob length varied significantly, however, cob girth remained non significant. The maximum cob length (16.5 cm) was recorded in T_5 that was statistically superior to T_2 and T_9 treatments. A significant difference was noted in number of grains per row and number of grains per cob where weed free crop recorded significantly higher values than T_2, T_3, T_7, T_8 and T_9. Since number of grain per row depends on cob length, hence the significant variations in cob length may be reasoned to differences in number of grains per row and number of grains per cob. Number of grain rows remained statistically unaffected which may be attributed to at par variation in cob girth. Single cob weight was the highest in T_3 that was significantly more than T_2, T_4 and T_9. Number of cobs/ha did not vary significantly however, maximum and minimum values were under weed free and weedy condition, respectively. Similar results were also obtained by Rao *et al.* (2009).

Table 1: Effect of weed management on growth and yield attributes of maize

Treatments	No. of plants (/ha)	Plant height (cm)	50% tasseling (days)	50% silking (days)	Cob length (cm)	Cob girth (cm)
T_1:Atrazine @1.0 kg a.i./ha, PE +1 HW	80,555	223	42.0	46.3	15.9	14.1
T_2:Metribuzine@0.25 kg a.i./ha, PE+ 1 HW	76,851	202	43.0	47.6	14.5	13.2
T_3: Alachlor @ 0.5 kg a.i./ha, PE +Atrazine@ 05 kg a.i./ha, PE+ 1 HW	75,000	239	42.0	47.3	15.7	13.7
T_4: Glyphosate @ 1.0 kg a.i./ha PE+Atrazine@ 375 g a.i./ha+Alachlor @ .5 kg a.i./ha, PE+1 HW	79,629	239	43.0	47.3	16.0	13.3
T_5: Glyphosate @ 1.0 kg a.i./ha, PE + 2,4-D EE @ 0.1 kg a.i./ha, POE	75,000	233	42.0	47.0	16.5	13.5
T_6: Atrazine@ 0.5 kg a.i./ha, PE + 2,4-D EE @ 0.4 kg a.i./ha, POE	82,407	243	42.6	46.3	16.4	13.4
T_7: Maize + Cowpea	78,703	229	42.0	46.6	16.3	14.0
T_8: Maize + Mungbean	76,851	222	43.0	46.3	15.5	13.4
T_9: Weedy check	69,444	214	42.6	47.0	13.7	13.0
T_{10}: Weed free	82,407	241	42.3	46.0	15.9	13.3
SEm ±	1,036	8.4	0.5	3.3	0.54	0.35
C.D. at 5%	3,080	25	NS	NS	1.6	NS

Table 2: Effect of weed management on yield attributes and cob yield of maize

Treatments	Number of grain rows per cob	Number of gain per rows	Number of gain per cob	Single cob weight (g)	No. of cob (/ha)	Cob yield (kg/ha)
T_1:Atrazine @1.0 kg a.i./ha, PE +1 HW	13.8	30.4	419.5	137	88,888	11,759
T_2:Metribuzine@0.25 kg a.i./ha, PE+ 1 HW	13.7	28.5	390.5	126	79,629	9,768
T_3: Alachlor @ 0.5 kg a.i./ha, PE + Atrazine@ 05 kg a.i./ha, PE+ 1 HW	13.9	28.8	400.2	141	84,259	11,509
T_4: Glyphosate @ 1.0 kg a.i./ha PE + Atrazine@ 375 g a.i./ha+Alachlor @ 0.5 kg a.i./ha, PE+1 HW	13.7	30.5	417.9	125	80,555	9,722
T_5: Glyphosate @ 1.0 kg a.i./ha, PE + 2,4-D EE @ 0.1 kg a.i./ha, POE	13.8	30.7	423.5	133	87,962	11,435
T_6: Atrazine@ 0.5 kg a.i./ha, PE + 2,4-D EE @ 0.4 kg a.i./ha, POE	13.7	30.6	419.1	137	87,962	11,481
T_7: Maize + Cowpea	13.6	29.2	397.2	131	86,111	10,925
T_8: Maize + Mungbean	13.6	29.4	399.8	128	89,814	10,972
T_9: Weedy check	13.5	26.5	357.9	108	72,222	7,685
T_{10}: Weed free	13.8	30.8	425.2	139	92,592	12,361
SEm ±	0.16	0.4	7.3	5.0	4,873	533
C.D. at 5%	NS	1.2	21.8	14.9	NS	1,585

The cob yield was the maximum under weed free treatment and was significantly higher than T_2, T_4 and T_9. Though grain yield was recorded significantly greater under weed free treatment but remained at par with T_1, T_4, T_5, T_6 and T_7 (Table 3). Significantly the lowest grain yield was noted under weedy condition. The maximum stover yield was under T_6 that was significantly similar to T_3, T_4, T_5, and T_{10} whereas the lowest value was noted under weedy treatment. Crop weed competition affected plant growth and yield attributes and as a result of this cob and grain yield differed significantly. The highest grain yield of maize in weed free treatment was mainly due to minimum crop-weed competition throughout the crop growth period, thus enabling the crop for maximum utilization of nutrients, moisture, light and space which influenced the growth and yield attributes (Hawaldar and Agasimani, 2012). Thus, the improvement in growth and yield attributes was as a consequence of lower crop-weed competition. These results are in conformity with the findings of Kamble *et al.* (2005).

At 60 DAS, significantly higher weed dry weight was recorded in weedy check as compared to rest of the treatments except T_2, T_3 and T_5 (Table 3). This could be attributed to higher and uninterrupted growth of weeds and total weed population which utilized growth factors effectively. In contrast to this significantly lower total weed dry weight was noticed in Maize + Cowpea and Maize + Mungbean. It was mainly due to control of weeds attributed to smothering effect of cover crop which resulted in reduced dry matter of weeds. The variation in weed dry weight could be attributed to variation in weed population. The data presented are in conformity with that of Ramesh and Nadanssababady (2005). Since, weed control efficiency depends on weed dry weight hence, a remarkable difference in weed control efficiency was recoded among treatments. Intercropping of cowpea showed the highest weed control efficiency whereas Metribuzine@0.25 kg *a.i.*/ha, PE+ 1 HW was the poorest. The weed index was the highest in T_6 (4.02) followed by T_4 (8.87) whereas weedy treatment had the lowest value (43.55). Lower weed index among the herbicides was recorded with pre-emergence application of Metribuzine@ 0.25 kg *a.i.*/ha supplemented one hand weeding at 25 days after sowing. The differences in weed index could be attributed to difference in grain yield of maize.

Economic analysis of various weed control measures revealed that maximum cost of cultivation was in weed free treatment owing to money spent on three hand weeding (Table 4). As a result of more grain yield gross return was the highest in Maize + Cowpea intercropping and it remained at par with Maize + mungbean and weed free condition. Maize + Cowpea

Table 3: Grain and stover yield of maize, weed dry weight, weed control efficiency and weed index as influenced by weed management

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Weed dry weight (g/m2)*	Weed contro control efficiency (%)	Weed Index (%)
T_1:Atrazine @1.0 kg a.i./ha, PE + 1 HW	5,231	20,509	3.95 (15.26)	37.8	8.87
T_2:Metribuzine@ 0.25 kg a.i./ha, PE+ 1 HW	4,398	18,842	4.57 (20.63)	15.9	23.38
T_3: Alachlor @ 0.5 kg a.i./ha, PE + Atrazine@ 05 kg a.i./ha, PE+ 1 HW	4,722	23,287	4.22 (17.59)	28.3	17.73
T_4: Glyphosate @ 1.0 kg a.i./ha PE + Atrazine@ 375 g a.i./ha+ Alachlor @ 0.5 kg a.i./ha, PE + 1 HW	5,231	23,009	3.79 (14.35)	41.5	8.87
T_5: Glyphosate @ 1.0 kg a.i./ha, PE + 2,4-D EE @ 0.1 kg a.i./ha, POE	5,138	23,611	4.11 (16.58)	32.4	10.49
T_6: Atrazine@ 0.5 kg a.i./ha, PE + 2,4-D EE @ 0.4 kg a.i./ha, POE	5,509	26,805	3.68 (13.25)	46.0	4.02
T_7: Maize + Cowpea	4,907	20,185	2.14 (4.23)	82.8	14.51
T_8: Maize + Mungbean	4,490	17,407	2.30 (4.84)	80.3	21.78
T_9: Weedy check	3,240	14,675	4.98 (24.53)	-	43.55
T_{10}: Weed free	5,740	23,194	1.13 (0.78)	-	-
SEm ±	334	1444	0.31	-	-
C.D. at 5%	993	4,291	0.93	-	-

*Transformed values ?[(x+0.5)], Figures in the parentheses indicate original values

system also fetched maximum net return (Rs. 62,789/ha) that was significantly higher than weed free treatment by Rs.13,088/ha but remained statistically at par with Maize + mungbean and Atrazine @ 0.5 kg *a.i.*/ha, PE + 2,4-D EE @ 0.4 kg *a.i.*/ha, POE. The higher net return in these treatments could be attributed to higher grain yield and lower cost of cultivation.The bonus grain yield of cowpea (4.2 q/ha) in Maize + Cowpea treatment made it superior to weed free crop in terms of monetary return. All chemical treatments except T_2 were at par with weed free treatment with respect to net return. Benefit cost (B:C) ratio was also highest (3.08) in Maize + Cowpea, indicating this treatment more remunerative. This was mainly due to higher economic yield, net returns and lower cost of cultivation Maize grown under weedy situation had minimum gross return, net return and B:C ratio.

Table 4: Economics of weed management in maize

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha))	Net return (Rs./ha)	B:C ratio
T_1:Atrazine @1.0 kg a.i./ha, PE+ 1 HW	22,593	68,526	45,933	2.03
T_2:Metribuzine@ 0.25 kg a.i./ha, PE+ 1 HW	22,589	57,614	35,025	1.55
T_3: Alachlor @ 0.5 kg a.i./ha, PE + Atrazine@ 05 kg a.i./ha, PE+ 1 HW	22,643	61,858	39,215	1.73
T_4: Glyphosate @ 1.0 kg a.i./ha PE + Atrazine @ 375 g a.i./ha+ Alachlor @ 0.5 kg a.i./ha, PE+ 1 HW	23,853	68,526	44,673	1.87
T_5: Glyphosate @ 1.0 kg a.i./ha, PE + 2,4-D EE @ 0.1 kg a.i./ha, POE	20,258	67,308	47,050	2.32
T_6: Atrazine@ 0.5 kg a.i./ha, PE + 2,4-D EE @ 0.4 kg a.i./ha, POE	19,907	72,168	52,261	2.63
T_7: Maize + Cowpea	20,393	83,182*	62,789	3.08
T_8: Maize + Mungbean	20,393	71,419*	51,026	2.50
T_9: Weedy check	18,493	42,444	23,951	1.30
T_{10}: Weed free	25,493	75,194	49,701	1.95
SEm ±	-	4,377	4,377	-
C.D. at 5%	-	13004	13004	-

* Gross return including the yield of cowpea and mungbean 4.2 and 2.8 q/ha, respectively.
Minimum support price (2013-14) of maize and mungbean are Rs. 1,310 and 4,500/q, respectively. Market price of cowpea Rs. 4,500/q

Table 5: Performance of succeeding wheat crop after weed control treatment in maizein maize

Treatments	Plant heigh (cm)	Number of effective tillers (/ m^2)	Grain yield (kg/ha)	Biological yield (kg/ha)
T1:Atrazine @1.0 kg a.i./ha, PE+ 1 HW	80	487	4,153	10,370
T2:Metribuzine@ 0.25 kg a.i./ha, PE+ 1 HW	81	627	4,471	10,608
T3: Alachlor @ 0.5 kg a.i./ha, PE + Atrazine@ 05 kg a.i./ha, PE+ 1 HW	73	553	4,154	9,920
T4: Glyphosate @ 1.0 kg a.i./ha PE + Atrazine@ 375 g a.i./ha+ Alachlor @ 0.5 kg a.i./ha, PE+ 1 HW	76	473	4,312	10,582
T5: Glyphosate @ 1.0 kg a.i./ha, PE + 2,4-D EE @ 0.1 kg a.i./ha, POE	75	533	4,392	10,608
T6: Atrazine@ 0.5 kg a.i./ha, PE + 2,4-D EE @ 0.4 kg a.i./ha, POE	78	493	4,074	10,105
T7: Maize + Cowpea	77	560	4,153	10,370
T8: Maize + Mungbean	75	487	4,127	10,000
T9: Weedy check	78	607	4,233	10,264
T10: Weed free	77	533	4,312	10,502
SEm ±	2	60	352	524
C.D. at 5%	NS	NS	NS	NS

Wheat

The growth in terms of plant height and yield attribute *viz*., number of effective tillers of succeeding wheat crop remained non significant among all the treatment (Table 5). Grain and biological yields of wheat in all the treatments were statistically equal. It clearly indicated that different herbicide applied in preceding maize crop did not leave their residual toxicity effect on succeeding wheat crop (Table 5). After- effect of legumes under cover cropping of cowpea and mungbean in maize was also not observed on wheat. Wheat can be grown after maize without any deleterious carryover effect of alone application of atrazine and metribuzin as well as their combined application in maize. These results are in accordance with the results of Sharma and Pankaj (2013).

CONCLUSION

Intercropping of maize with cowpea or mungbean is helpful in reducing weed infestation along with more profit compared to herbicide treatment. Among chemical control, the application of Atrazine @ 1.0 kg a.i/ha PE followed by 2, 4-D EE @ 0.1 kg a.i/ha POE was found the most effective. Wheat crop can be grown successfully as succeeding crop after application of different herbicides in maize crop.

REFERENCES

Buchler, D.D., Kohler, K.A. and Foster, M. (2001). Corn, soybean and weed responses of spring-seeded smother plants. *J Sustain Agric*., 18:6379.

Ghosheh, H.Z., Bsoul, E.Y and Abdullah, A.Y. (2005). Utilization of alfalfa (*Medicago sativa* L.) as smother crop in field corn (*Zea mays* L.). *J Sustain Agric*., 25:517.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons, New York.

Hawaldar, S. and Agasimani, C.A. (2012). Effect of herbicides on weed control and productivity of maize (*Zea mays* L.). *Karnataka J. Agric. Sci.,* 25 (1):137-139.

Kamble, T.C., Kakade, S.U., Nemade, S. U., Pawar, R. V. and Apotikar, V.A. (2005). A integrated weed management in hybrid maize. *Crop Res. Hisar,* 29(3): 396-400.

Patel, V.J., Upadhyay, P.N., Patel, J. B. and Meisuriya, M. I. (2006). Effect of Herbicide mixtures on weeds in *kharif* maize (*Zea mays* L.) under Middle Gujarat conditions. *Indian J. Weed Sci.,* 38 (1& 2): 54-57.

Rao, A.S., Ratnam, M. and Reddy, T.Y. (2009). Weed management in zero-till sown maize. *Indian J. Weed Sci.,* 41(1 & 2): 46-49.

Ramesh, G., Nadanassababady, T. (2005). Impact of herbicides on weeds and soil ecosystem of rainfed maize (*Zea mays* L.). *Indian J. Agric. Res.,* 39(1): 31-36.

Sharma, R and Pankaj (2013). Direct and residual effect of different herbicides applied in maize (*Zea mays*) on weed dynamics and productivity of maize and succeeding wheat (*Triticum aestivum*). *Indian J. Agrl Sci*., 83 (1): 7782.

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