WEED STUDY OF MULCHED FIELD IN MONGOLIA

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ABSTRACT

As climate researchers predict, the surface air temperature increase rate in Mongolia is expected to be 3 times greater than the global average (0.77^0C), and may well exceed 2.0^0C, far greater than the maximum permissible rate. The surface temperature is estimated to rise at the rate of 2.7-3.6^0C in 2030-2040, and further 3.6-6.3^0C in 2080-2099, which can disrupt water cycle and precipitation patterns: mild increase in winter precipitation, as opposed to significant reduction in spring, summer and autumn precipitation, with estimated increase in evaporation by 7-10 times.

Mongolia has an extreme continental climate, and its' plant cover is loose, soil humus layer is thinner, has mainly light mechanically compounded soil, low precipitation in winter, dryness in spring. On the other hand, using a short rotation of grain fallow has created agro-ecological conditions such as vulnerable and a poorly-recovered environment. Under this situation, crop technologies need to be adapted to mitigate these negative consequences of the climate. Creating a large amount of plant covering will protect the soil from direct sunlight, and its consequences. The final result of our research work is focused on identifying the changes of soil moisture regime of the covered area furthermore, the positive and negative impacts on the soil, decrease of weeds.

As a result of covering soil surface with straw, temperature reduced by 2 degrees during the planting season, weeds grew 3.4 times less, moisture of soil increased by 5.5 mm and plantlet of wheat seeds increased by 6.2 per cent respectively.

As an average of study years weed quantity at mulched variants was less by 14 pc/m^2 and less weight 7.1 g/m^2 than mulch less variants, this was increased weight of main crop by 36.6 g/m^2 and yield by 1.8 t/ha, respectively.

Keywords: *weed* species, *straw mulching, soil moisture, soil temperature, herbicide, yield.*

INTRODUCTION

Totally, 2239 species are growing in Mongolia (V.I.Grubov 1982), of which 366 species are distributing at crop field and causing hazard (G.Tserenbaljid 1979, J.Mijiddorj 1981).

According to the excursion weed study of Institute for Plant Protection (IPP) at crop field in 1989-1991, more than 60% of fields were with weed infestation which is above medium level. If see in species, 36.1% was grass (***Agropyron repens, Avena fatua, Panicum milliaceum)***, 23.8% was ***Fagopyrum tataricum, Potentilla bifurca, Polygonum convolvulus***, which are resistant against 2.4D type's herbicide, 40.1% was ***Polygonum divarcatum, Chenopodium, Sonchus arvense, Artemisia sieversiana***, which are vulnerable weeds to herbicide (J.Sersmaa & J.Davaasuren 1991).

It is impossible to obtain abundant yield without weed control. According experiment result of weed threshold value at spring wheat field, which conducted at the Institute for Plant

and Agricultural Sciences (IPAS) in Darkhan, it is proven that weed weight has more impact than quantity of weed. Correlation coefficient of the weight impact was 0.63; weed species have different impact as well.

1.6 t/ha green mass of ***Panicum miliaceum,*** which grown at spring wheat field, reduces wheat yield by 2.1 t/ha; 1.1 t/ha ***Avena fatua*** reduces wheat yield by 1.2 t/ha; 2.5 t/ha ***Chenopodium album*** reduces wheat yield by 1.5 t/ha, respectively (G.Davaadorj & G.Enkhtsetseg 1988). ***Panicum milliaceum*** is relatively drought resistant weed; it composes 30.3-65.7% of weed of cereal field (J.Sersmaa 1998). Yield loss depends on weed species, ***Cirsium arvence*** reduces yield by 38%, ***Sonchus arvence*** reduces 44.6%, single grass can reduce yield by 18-22%, respectively (P.F.Ionin 1980).

In chemical fallow, if herbicide type and spraying term is chosen correctly, weed is reduced increasingly, especially perennial weed is reduced, perennial weed elimination rate was 80.9-84.1%, it was higher by over 20% than mechanical fallow (S.Saikhantsetseg, B.Baatartsol, J.Nambar 2014). The more straw mulch, the less weed level was at the field (G.Gungaanyam 1998). As average of study years, field with 3.0-6.0 t/ha mulch had less weed by 1.4-1.8 times. When straw mulch increases, organic acid, which formats due to desegregation of straw, reduces quantity of small seeded weeds such as ***Chenopodium*** and ***Panicum milliaceum***.

In dry, arid Mongolian condition, due to increased number of mechanical cultivation of soil for controlling weed, soil fertility is decreasing and effected by erosion. Hence, agro-ecosystem is unstabilised. Therefore, for reducing erosion effect and stabilizing agro-ecosystem, there is an existing requirement for introducing mulch technology in front of our researchers.

RESEARCH METHODOLOGY

Place of Study and Duration

Field research was conducted in 2013-2015 at experimental site of the Institute of Plant and Agricultural Sciences in Darkhan –Uul province Khongor Soum.

On the 15th of May, “Darkhan-34” varieties of wheat were planted by “John deer” seeder. The seeds sprinkled on the 3 million/ha land, in a depth of 4 cm and 19 cm between the rows.

METHODS FOR RESEARCH AND ANALYSIS

- Soil warming measured on 0-5, 5-10 cm by soil temperature meter /thermometer /
- Soil moisture content is measured in a depth of 0 - 100 cm, by weight method of 10 cm frequency.
- The density of the soil surface (0-10 cm) was determined.
- The distribution and density of weed population in plots were evaluated by using I.I.Liberstein and A.I.Tulikov’s method for defining weed distribution. Number of weed species and weed plants in 1m^2, placed on 4 different randomly selected locations within each plot, were counted. Overall weed infestation of plots was rated on 5-point scale, with 1 being least and 5 being critically infested.

- Following equation was used to evaluate the effectiveness of the herbicides applied on crops in rotation, based on the decline of weeds in quadrant of 1x1m area. Weed plants were counted before and after herbicide application.
  Weed decline = NWAH / NWBH x 100%
  WD-Decline of weed plants, by percentage
  NWAH-Number of weed plants after application of herbicide, weed plants/m2
  NWBH- Number of weed plants before application of herbicide, weed plants/m^2
- Crops and weeds in each experimental plot were sampled during the plants' flowering stage, counted and weighted to determine the percentage of weed biomass (wet) in the crops.

EXPERIMENT OF FERTILIZED VERSIONS:

- ✓ Mulched
- ✓ Mulchless

RESEARCH RESULT

During the experiment, the 3 t/ha straw on the surface of land which were created unnaturally should be protected from the solar overheating. So that, it is necessary to reduce the evaporation of soil moisture during the overheating, weeds and spring season and to increase the moisture supply at the early stages of crop development.

They are approved by research result and need to be improved in future. For example, In a result of the two years study, before planting 15th of May, The soil warming tested both in covered and uncovered tillage. The temperature was 13.3 degrees in the depth of 0-5 cm and 7.55 degrees in the depth of 5-10 cm on the uncovered tillage which were 2°C higher in a depth of 0-5 cm and 1,5°C warmer in the depth of 5-10 cm compared to the covered tillage.

The difference in soil heat detected more in 2015 when the temperature fluctuation of days and nights was higher. So the differences are 9°C warmer in the depth of 0-5 cm, and 1° C warmer in a depth of 5-10 cm. According to these findings, creating 3 tons of straw covering can be able to reduce the surface of soil warming by 2 degrees during planting (15^{th} of May).

Weed quantity at mulched and mulch less field, which sown on May 15^{th}, was 20.5 pieces in average. It was fewer by 49 pieces or 3.4 times at mulched field than mulch less field.

Soil moisture was higher at mulched field as an average value of experimental two years, less weed infestation is connected to insufficient soil warmth.

Soil warmth was determined by thermometer at 0-5cm and 5-10 cm depth of soil. Soil warmth was at 0-5cm depth lower by $3.8^{O}C$, at 5-10 cm depth lower by $1.5^{O}C$ than the mulch less field. Mulch obstacles sun light reduces soil temperature and increase day and night fluctuation, this causes less germination of weeds. Slow increase of soil temperature and less quantity of weeds are connected to insufficient warmth. According to study years observation, weed germination was lower at mulched field; soil of mulch less field was warmer therefore weed seed was germinating earlier. If can create sufficient mulch cover at the field, straw mulch can disturb weed germination.

Table1. Study result of the soil moisture, soil heat, field germination, weed of the mulched and mulchless tillage *(2014-2015)*

Version	Soil heat, C^0		Soil moisture, mm		Wheat field germination, %			Sowing before weed, per/m^2
	0-5 cm	5-10 cm	0-30 cm	0-50 cm	2014	2015	Average	
Mulched	13.3	8.05	46.8	70.9	55.6	55.0	55.3	69.5
Mulchless	11.3	6.55	47.5	76.5	50.6	52.9	51.7	20.5

For planting and starting a harvest, the most crucial thing is starting point and the first stage of harvesting is to create a condition of normal seed germination. The germination of covered field was more than 5.0 percent in 2014 and 2.1 percent in 2015 respectively compared to the uncovered field. This field germination is explained by forming the proper ratio of moisture and heat and also germinating seeds equally. (Table1).

If see species composition of weed in our experimental plots, there were grown perennial weeds such as ***Poligonum convolvulus L, Leptopyrum fumariodes, Corispermum declinatum, Panicum Milliaceum, Cannabis ruderalis Janisch, Chenopodium Album L, Artemisia sieversiana wild, Salsola collina Pall, Kochia scoparia, Euphorbia discolor, Sonchus arvensis L.***

Almazis herbicide was sprayed with 8-10g/ha norm at tillering stage of spring wheat at both mulched and mulchless variants.

Weed quantity before spraying herbicide at tillering stage of wheat was 166.5 pc/m^2 with high weed infestation as of two years average; after spraying herbicide weed quantity reduced by 117.5 pc/m^2 or 70.4%; weed was decreased by 60.5% at mulchless field, respectively.

Table 2. Decrease of weed in wheat

Version	Year	Spray herbicide		Decrease of weed	
		Before, per/m^2	After, per/m^2	Number, pc/m^2	%
Mulched	2014	153	48	105	68.6
	2015	180	50	130	72.2
	Average	166.5	49	117.5	70.4
Mulchless	2014	118	67	51	43.2
	2015	467	103	364	77.9
	Average	292.5	85	207.5	60.5

According to cover-projection methodology, which was developed by I.I.Liberstain and A.I.Tulikov, weed was evaluated scores 1-5; weed infestation level at flowering stage of wheat was at mulched and mulchless variants 35-49 pc and those were evaluated with low weed infestation. This was connected to effectiveness of chemical weed control at tillering stage of wheat. Field germination rate was 51.7-55.3% at mulched and mulchless fields.

Table 3. Properties of mulched and no mulched field, 2014-2015

Version	Year	Wheat field germination, %	Total weed, per/m^2	Weight of weed, g/m^2	Weight of crop, g/m^2	Percentage of weed in total biomass flowering stage, %	Seed yield t/ha
Mulched	2014	55.6	45	26.0	281.0	8.4	1.42
	2015	55.0	25	19.73	217.4	4.5	0.74
	Average	***55.3***	***35***	***22.9***	***249.2***	***6.4***	***1.08***
Mulch less	2014	50.6	67	39.6	266.0	12.9	1.28
	2015	52.9	31	20.48	159.2	7.6	0.53
	Average	***51.7***	***49***	***30.0***	***212.6***	***10.2***	***0.90***

Weed weight rate in biomass was 6.4%, weed infestation was very low (score 1) at mulched variant; but weed weight rate in biomass was 10.2%, weed infestation was low (score 2) at medium level.

Weed at mulched variants was less by 14 pc/m^2 and less weight 7.1 g/m^2 than mulchless variants; this was increased weight of main crop by 36.6 g/m^2 and yield by 1.8 t/ha, respectively.

According to our study, weed weight rate in biomass was lower by 1.6 times at mulched field, this result is approving researcher G.Gungaanyam's experiment result that the more mulch the reduced weed. Wheat yield at mulched field was 1.8 t/ha, which was higher by 16.7% than mulchless field's yield.

DISCUSSION

1.6 t/ha green mass of ***Panicum milliaceum*** which grown at spring wheat field, reduces wheat yield by 0.21 t/ha; 0.11 t/ha ***Avena fatua*** reduces wheat yield by 0.12 t/ha; 0.25 t/ha ***Chenopodium album*** reduces wheat yield by 0.15 t/ha, respectively (G.Davaadorj&G.Enkhtsetseg 1988). ***Panicum milliaceum*** is relatively drought resistant weed; it composes 30.3-65.7% of weed of cereal field (J.Sersmaa 1998). Yield loss depends on weed species, ***Cirsium arvence*** reduces yield by 38%, ***Sonchus arvence*** reduces 44.6%, single grass can reduce yield by 18-22%, respectively (P.F.Ionin 1980).

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In chemical fallow, if herbicide type and spraying term is chosen correctly, weed is reduced increasingly, especially perennial weed is reduced, perennial weed elimination rate was 80.9-84.1%, it was higher by over 20% than mechanical fallow (S.Saikhantsetseg, 2014).

CONCLUSION

1. As a result of covering soil surface with straw, temperature reduced by 2 degrees during the planting season, weeds grew 3.4 times less, moisture of soil increased by 5.5 mm and plantlet of wheat seeds increased by 6.2 per cent respectively.
2. Weed quantity before spraying herbicide at tillering stage of wheat were 166.5 pc/m^2 with high weed infestation as of two years average; after spraying herbicide weed quantity reduced by 117.5 pc/m^2 or 70.4%; weed was decreased by 60.5% at mulchless field, respectively.
3. As an average of study years, weed quantity at mulched variants was less by 14 pc/m^2 and less weight 7.1 g/m^2 than mulchless variants; this was increased weight of main crop by 36.6 g/m^2 and yield by 0.18 t/ha, respectively /r=0.7/.

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BRIEF INTRODUCTION OF THE AUTHOR

Saikhantsetseg Sosorbaram graduated from Mongolian University of Life Sciences in 1997 and majored in Agronomy. In 2000, I received master's degree in "Sowing period influence of yield for spring wheat", in 2014 completed Ph.D's thesis on "Possibility to use no tillage and straw mulch technologies for fallow and cereal rotation in central cropping zone of Mongolia" Since 1997 I have worked as a researcher at the crop farming division of Institute of Plant and Agricultural Sciences. I'm working in the field of soil cultivation, crop rotation and weed control.