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Economic assessment and comparison of two kind of irrigation'120' and '140' mm by winter wheat in loess soils with diffuse double layers

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Abstract:

Two tests during two consecutive years to evaluate the use of fertilizers and irrigation water along with 120 mm and 140 mm in 2009 and 2010 with the planting of winter wheat. After obtaining results and related indicators to assess economic performance data was analyzed using local spending. The report showed that 140 mm of irrigation with fertilizer consumption basis for all treatments completely randomized block design and implementation of irrigation and the use of equipment is not economic. In a second experiment split plot design with the main plots and subplots of irrigation and fertilizer was performed. In surface irrigation without additional any fertilizer and manure more economical basis than the drip irrigation and sprinkle was seen .The main cause of high-performance with irrigation refer to diffusion double layer (DDL) with particularly high levels of potassium in the presence of water in the soil and release consecutively.

Keywords: Wheat – Loess soils – Special Surface - Economic

Introduction:

Today, water scarcity and high cost of water has led in many cultures there is no economic efficiency. In first design, with 7 treatments and 3 replications in the field of Gorgan University of Agricultural Sciences and natural resources was conducted in an area of 1500 square meters. Water treatment include, Surface irrigation, sprinkle irrigation and drip. water treatment basin irrigation intensity of 240 mm / h and sprinkler irrigation intensity of 140 mm / h and drip irrigation intensity of 60 mm / h was carried out., dry farming treatments include without cultivation without irrigation (control of water stored) - black plastic between the rows and rows of clear plastic and rain fed treatment. Irrigation system using the specified output of 6 times during the growing season and 140ml of water was added to the plots. In the second design three rate of Urea, Potassium Sulfate and Di-Ammonium Phosphate were a. 0,0,0, b. 200,200 and 350 and c. 300,300 and 525 kg/ha respectively(fertilizers). As subplots, flood, sprinkle and drip irrigations were factored in main plots. Each plots irrigated with 120 mm. irrigation intensity for flood, sprinkle and drop were 252,168,102 mm/hour. Flood and Drip irrigation methods still improved yield slightly with fertilizer application which may go less interactions. Increasing humidity by soil reduced mechanical resistance may also cause improved roots development potassium absorption, number of clusters and yield at unit of area. All data were compared at 5 % with SAS software. Surface irrigation was the highest yield to calculate the costs and comparison with the treatment of dry-farming economic efficiency was found. In loess soils just watering the soils could create high added value.

Illite clay layers may be blocked by drying and this causes limited use of potassium for the plant. With respect to potassium higher quantities for extraction by ammonium acetate and its higher densities (concentrations) within the soils with specific surface area in test site, potassium slow diffusion (exchange of potassium) and the existing synthetic exchange potassium in Diffusion Double Layer (DDL) may hinder plant adequate absorption and lead to reduced yield [1], [2], [3] and [4].

Materials and Methods:

This study was conducted in research farmland of Gorgan University of Agriculture Sciences and Natural Resources, which is situated on 54°30´E and 37°45´N.
Field soil has been classified according to American classification (Typic Haploxerept)
By application of ethylene glycol mono ethyl ether, soil specific surface area was measured . The value of specific surface area was measured 132m²/gr for the given soil. (Carter et al, 1986).[5]
The length and width of 6 x 4 plots were divided. All the plots with 200 kg per hectare potassium sulfate and 200 kg per hectare urea (twice) were enrichment. Immediately winter wheat seeds in 15 rows with a distance of 20 cm between rows 20 cm were planted. In order to prevent the infiltration of water between the plot of each plot to another plot of 4 meters was observed. in clear plastic and black

plastic strip porous treatments between the rows were set up to absorb the impact of the sun 's heat loss or gain of moisture compared to dry and wet check. The quantity of transferred water was 3.3m³ in any plot at each step which is equal to 137mm water. Dropping, rain- water and flooding irrigation systems included water transfer system and the needed equipment for realization of study goals, which were installed and plastic, black and transparent mulches with 20cm width and similar holes (to penetrate rain- water) were inserted within intervals in cultivation rows. By construction of water transfer equipment and water pumps designed identically in three plots. Through construction of surface spectra along each row with drippers at 20cm intervals, dropping irrigation was planned and implemented and finally flooding irrigation was done normally by releasing water uniformly over plot surface. In 2th design on the same date, Zagros wheat seed were planted in some plots with 4×6m dimensions. Seeds were sprouted on 29nd. Fertilizers were Urea, Potassium Sulfate and Di-ammonium phosphate and rates for nil, optimum and high applications were a. 0,0,0, b. 200,200 and 350 and c. 300,300 and 525 kg/ha respectively. As subplots, flood, sprinkling and drip irrigations were factored in main plots (fertilizers). Each application used 120 mm to minimize leaching and more rainfall reduced number of irrigations to three. Irrigation treatments increased potassium uptake and yield with no fertilizer application. Fertilizers also improved nutrient uptake and yield with dry land culture which may mean irrigation substitutes fertilizer application. Flood and drip irrigation methods still improved yield slightly with fertilizer application which may show some minor interactions. Nitrate leaching was not significant in the second year with lower irrigation depth.

The Zagros wheat seed in plots with 4×6 m in length and width were performed. Split plot experimental design, 4 Irrigation and 3 rate of compound fertilizer. The main plots with fertilizer urea, potassium Sulphate and Di-ammonium Phosphate at a level of a: 0, 0,0, kg/ha b: 200,200 and 350 kg/hr, and c: 1.5 times of this amount, is 300, 300 and 525 kg per hectare in the 29 Dec 2009 was added to the soil. Four subplots include flood, sprinkle, drop and dry were performed. Plots were irrigated 0.75 m3 that equal 12 cm water per m2.The seeds were sown on Jan28. Specific surface was measured (132 m2/gr) [5].

Results and Conclusion:

Table 1 shows the yield and the indices in first design. The highest seed yield and total yield of the basin irrigation. The highest and the lowest yield for the treatment of clear plastic to 3770kg / hr and 2860kg / hr , respectively.

Table 1 : yield and yield indices

Treatment	Compared of average									
	Mean Fertilized Stem in Bush	Mean Spikelet in Bush	Mean Length of Stem	Mean Seed per Cluster	Cluster No in $1m^2$	Grain Weight per Thousand gr	Chaffs Yield Kg/hr	Seed Yield Kg/hr	Biologic Yield Kg/hr	Index %
Drop Irrigation	**4.53^c**	**75.40^a**	**93.26^a**	**30.6^c**	**535.5^c**	**38.17^b**	**4210^b**	**3420^b**	**7630^c**	**44**
Rainwater Irrigation	**4.73^b**	**$63. 8^c$**	**87.5^c**	**28.90^d**	**571.2^a**	**37.29^c**	**4480^a**	**3350^c**	**7830^b**	**42**
Flood Irrigation	**4.80^a**	**66.7^b**	**90.1^b**	**33.36^b**	**557.4^b**	**40.52^a**	**4550^a**	**3770^a**	**8320^a**	**45**
Black Plastic	**4.40^d**	**62.2^d**	**85.2^d**	**40.01^a**	**524.7^d**	**31.74^e**	**3730^c**	**3370^c**	**7100^d**	**47**
Transparent Plastic	**4.06f**	**59.40^e**	**89.7^b**	**26.67^e**	**454.3^e**	**37.41^c**	**3440^d**	**2860^d**	**6300^e**	**45**
Dry- Farming Treatment	**4.13^e**	**63.80^c**	**85.50^e**	**32.70^b**	**451.1^e**	**35.12^d**	**3780^c**	**3330^c**	**7110^d**	**46**
LSD	**0.05**	**0.92**	**0.69**	**0.77**	**8.61**	**0.5**	**75.05**	**48.06**	**117.5**	**0.002**

Table 2 The physicochemical Properties

Table-2: Soil Physical- Chemical Properties (depth 0-30cm)												
Soil Texture	Sand	Silt	Clay	Azote Nitrate ppm	Ammonium Azote	Absorbable potassium by tetra phenyl borane sodium (ppm)	Organic Carbon OC%	Total Neutral Materials TNV %	Absorbable potassium by Ammonium Acetate ppm	Absorbable phosphorous ppm	Acidity of Saturated Vase	Electric Conductance Ds/m
Silty clay loam	**10**	**56**	**34**	**13.3**	**0**	**620**	**0.96**	**24**	**350**	**11.2**	**7.3**	**0.65**

Loess soil region, Gorgan University of Agricultural was a silty clay loam soil . According to havlin's works [6], with 13-15mgr/ kilogram soil nitrate in zero surface up to 30cm, there is no need to azotic fertilizer for production of 6 tons per hectare for wheat as well as with 12mgr/ kg phosphorus no need to phosphate fertilizer. It seems the given form for nitrogen belongs to colder regions in Gorgan city and for those areas with Gorgan climatic conditions where synthesis of organic substances is done more quickly it requires using azotic fertilizer and probably in higher quantity. The quantity of absorbable potassium was 350 mgr/ kg with acetate so based on havlin's works [6] there is no need to azotic fertilizer with more than 160 mgr/ kg potassium. However, due to high specific surface and abundant Illite clay in the tested soils, wheat yield will be improved by giving fertilizer to soil. Soil texture within zero surfaces up to 30cm is the area of developing wheat in loamy- silty clay. (Table-2)

Table 3 Consumption water

Table-3: Water Chemical Properties:														
Classification	**Residual Sodium Carbonate RSC meq/l**	**Sodium Absorption Ratio SAR**	**Hardness ppm**	**Total Cations meq/l**	**meq/lit**								**Acidity**	**Total Dissolvable Salts TDS.mg/l**	**Electric Conductance Ds/m**
					Na^+	**Mg^{++}**	**Ca^{++}**	**Total Anions**	**Cl^-**	**$SO4^{--}$**	**$HCO3^-$**	**$CO3^{--}$**			
c2S1	**0.5**	**0.2**	**280**	**5.9**	**0.3**	**2.4**	**3.2**	**6.7**	**0**	**0.6**	**6.1**	**0**	**7.5**	**416**	**0.65**

(Table-3) According to classification of American Soil Salinity Lab (1954), since water EC is greater than 0.25 and lesser than 0.75, so water is classified by medium risk of salinity and because of this fact that RSC quantity is lesser than 1.25 and sodium absorption ration is lower than 7 then risk of soil basification with this water and reaction of both with sodium is low. Then the consumption water was no salty no salinity.

Table 4:comparison of costs in first design with 7 trt. and 3 rep.(140mm irrigation)

treatment		Seed income) In thousands (		Residual income) In thousands (	Costs) In thousands of rials (							The difference between income and expenses	Treatment difference of treatment dry-farming
	Seed Yield Kg/hr	Seed Kg **10,000 Rials**	Chaffs Yield Kg/hr	**Straw Kg 500 Rials**	Land clearing 1000	Ground rent	Water pricing 1500	Seed buying 100	fertilizer 200	Working 6000	Equipment		
Drop Irrigation	3420	34200	4210	**210/5**	1000	–	1500	100	200	6000	20000	5610	-20579
Rainwater Irrigation	3350	33500	4480	224	1000	–	1500	100	200	6000	10000	14924	-11265
Flood Irrigation	3770	37700	4550	227/5	1000	–	1500	100	200	6000	5000	24124	-2065
Black Plastic	3370	33700	3730	186/5	1000	–	–	100	200	6000	2000	24586	-1603
Transparent Plastic	2860	28600	3440	172	1000	–	–	100	200	6000	2000	19472	-6717
Dry- Farming Treatment	3330	33300	3780	189	1000	–	–	100	200	6000	–	26189	0

Table 5 - Comparison of Average main effect of irrigation and fertilization on yield and yield components of wheat in 2th design 12 treatment and three replications (120mm irrigation)

Treatment	Fertile stems per plant average	spikelet per crucible average	stem length average cm	The average number of seeds per spike	The weight of thousand seeds gr	Biological yield Kg/hr	straw yield Kg/hr	grain yield Kg/hr	Biological yield Kg/hr	Index percent %
Fertilization effect										
Normal fertilization(200kg/hr)	2.78^{b}	37.56^{a}	90.16^{a}	27.51^{a}	426.93^{b}	33.81^{a}	8836.6^{b}	4074.1^{a}	12910.9^{b}	31.7^{a}
Extra fertilization(300kg/hr)	2.75^{b}	37.28^{a}	89.56^{a}	27.35^{a}	461.9^{a}	33.67^{ab}	9347.5^{a}	4140.3^{a}	13387.9^{a}	31.0^{b}
With out fertilizer(control)	2.95^{a}	36.98^{a}	85.54^{a}	23.92^{b}	442.1^{ab}	32.17^{b}	8442.5^{c}	3567.5^{b}	12010^{b}	29.7^{c}
Irrigation Effect										
Water flooding	3.126^{b}	36.38^{b}	87.77^{a}	22.10^{d}	537.47^{a}	31.91^{b}	9933.3^{a}	4486.7^{a}	14420^{a}	31.3^{b}
Drip irrigation	3.346^{a}	43.48^{a}	91.11^{a}	25.31^{c}	481.53^{b}	34.07^{a}	9584.4^{b}	3990^{b}	13574.4^{b}	29.3^{d}
Sprinkler	2.746^{c}	36.06^{b}	85.89^{a}	27.67^{b}	401.3^{c}	34.85^{a}	7522.3^{d}	3626.1^{c}	11148.3^{d}	32.6^{a}
Without irrigation(dry)	2.103^{d}	33.18^{c}	88.93^{a}	29.96^{a}	354.3^{d}	32.03^{b}	8329^{c}	3606.7^{c}	11935.7^{c}	30.0^{c}

According to Table 5, along with consideration of various methods of irrigation and dry farming, increased use of fertilizer increased grain yield, straw and biological yield were. This increase in yield with normal and high amounts of fertilizer to produce grain and straw was significant compared to controls. Along with consideration of all rate of fertilizer, grain, straw and biologic yield by flood irrigation was highest into other treatments .Water flooding treatment was highest yield in grain and straw but sprinkler cultivation was less than control. This may cause by less infiltration on flood irrigation and diffuse the roots and increase the absorption of element in soil. Yield of grain, straw and biologic in drip irrigation into the sprinkler and dry treatment was further.

Table 6 - Average effect of irrigation and fertilizer levels on yield and yield components in 2th design 12 treatment and three replications (120mm irrigation)

Irrigation	no fertilizer							(equal 200 kgr/ hr of fertilizer)							(equal 300 kgr/ hr of fertilizer)						
Changing of sources	m.s.b	m.s.	m.d.	w.h	Kol.	Dan.	Bio.	m.s.b	m.s.	m.d.	w.h	Kol.	Dan	Bio.	m.s.b	m.s.	m.d.	w.h	Kol.	Dan.	Bio.
Water flooding	3.15^{a}	37.9^{b}	20.2^{c}	31.1^{b}	9600^{a}	4050^{a}	13650^{a}	3.1^{b}	35.7^{b}	23.0^{c}	32.3^{a}	10950^{a}	4650^{a}	14700^{a}	3.1^{b}	35.4^{b}	22.9^{c}	32.22^{a}	10150^{a}	4760^{a}	14910^{a}
Drip irrigation	2.75^{a}	41.2^{b}	31.5^{a}	33.1^{b}	8743^{b}	3900^{a}	12643^{b}	3.6^{a}	44.8^{a}	22.2^{c}	34.6^{a}	9980^{a}	3950^{b}	13930^{a}	3.6^{a}	44.4^{a}	22.1^{c}	34.47^{a}	10030^{a}	4120^{b}	14150^{a}
Sprinkler	3.20^{a}	36.2^{ab}	24.5^{b}	39.5^{a}	7220^{d}	3420^{b}	10640^{c}	2.5^{c}	36.1^{b}	29.3^{b}	32.5^{a}	7096^{b}	3746^{b}	10843^{c}	2.5^{c}	35.8^{b}	29.1^{b}	32.46^{a}	8250^{b}	3711^{b}	11961^{b}
Without irrigation(dry)	2.73^{a}	32.6^{b}	19.4^{d}	24.8^{c}	8207^{c}	2900^{c}	11107^{c}	1.8^{d}	33.6^{b}	35.3^{a}	35.6^{a}	8220^{b}	3950^{ab}	12170^{b}	1.7^{d}	33.3^{b}	35.1^{a}	35.55^{a}	8560^{b}	3970^{b}	12530^{b}

(m.s.b.) mean of fertile stem (m.s.) mean of spikelet (m.d.) mean of grains in spike (w.h.) weight of one thousand grains (kol) yield straw (dan.) grain yield (bio.) biological yield

According to Table 6, yield without fertilizer significantly has increased in all irrigation treatments than the rainfed plat. With normal and high amount of fertilizer, yield in dry farming was respectively 2900, 3950 and 3970 kg /hr. Therefore, irrigation is likely to increase nutrient uptake and grain yield can be increased. With sprinkler irrigation, grain yield without fertilization with conventional fertilizer and manure are respectively 3420, 3746 and 3711 kg /hr with irrigation and flooding, respectively, 4050, 4650 and 4760 kg /hr respectively. The importance of irrigation to increase yield in terms of fertilization is very significant. Regard to low access the yield by using fertilizer especially in irrigations plats it seems other mutual effect such as potassium diffusion and azote massive movement may be occurred. Beside the massive movement of elements and potassium diffusion, root developing and spread may cause in absorption and increment in the grain yield. More increase in yield was got only in irrigation treatment except sprinkle. With flood irrigation even without fertilizer, grain and biological yield had increased significantly. With a drop of water with the least expected and most of the washing water are nitrates. At harvest, the soil nitrate concentration with dry farming and irrigation methods of flooding and the drop was lower.

Table 7 Comparison of costs (no fertilizer) in 2th design (120mm irrigation)

treatment		Seed income) In thousands (		Residual income) In thousands (	Costs) In thousands of rials (							The difference between income and expenses	Treatment difference of treatment dry-farming
	Seed Yield Kg/hr	Seed Kg **10,000 Rials**	Chaffs Yield Kg/hr	**Straw Kg 500 Rials**	Land clearing1000	Ground rent	Water pricing600	Seed buying 100	fertilizer 0	Working 6000	Equipment		
Water flooding	4050a	40500	9600a	480	1000	-	600	100	0	6000	2000	31280	8970
Drip irrigation	3900a	39000	8743b	437	1000	-	600	100	0	6000	20000	11737	-10573
Sprinkler	3420b	34200	7220d	361	1000	-	600	100	0	6000	5000	21861	--449
Without irrigation(dry)	2900c	29000	8207c	410	1000	-	-	100	0	6000	0	22310	0

Table 8Comparison of costs (200 Kg/hr fertilizer) in 2th design (120mm irrigation)

treatment		Seed income) In thousands (		Residual income) In thousands (	Costs) In thousands of rials (							The difference between income and expenses	Treatment difference of treatment dry-farming
	Seed Yield Kg/hr	Seed Kg **10,000 Rials**	Chaffs Yield Kg/hr	**Straw Kg 500 Rials**	Land clearing1000	Ground rent	Water pricing600	Seed buying 100	fertilizer 200	Working 6000	Equipment		
Water flooding	4650a	46500	10950a	547	1000	-	600	100	200	6000	2000	37147	4536
Drip irrigation	3950b	39500	9980a	499	1000	-	600	100	200	6000	5000	27099	-5512
Sprinkler	3746b	37460	7096b	354	1000	-	600	100	200	6000	20000	9914	-22697
Without irrigation(dry)	3950ab	39500	8220b	411	1000	-	-	100	200	6000	0	32611	0

Table 9 Comparison of costs (300 Kg/hr fertilizer) in 2th design (120mm irrigation)

treatment		Seed income) In thousands (		Residual income) In thousands (	Costs) In thousands of rials (							The difference between income and expenses	Treatment difference of treatment dry-farming
	Seed Yield Kg/hr	Seed Kg **10,000 Rials**	Chaffs Yield Kg/hr	**Straw Kg 500 Rials**	Land clearing 1000	Ground rent	Water pricing 1500	Seed buying 100	fertilizer 300	Working 6000	Equipment		
Water flooding	4760a	47600	10150a	507	1000	-	600	100	300	6000	2000	38107	5280
Drip irrigation	4120b	41200	10030a	501	1000	-	600	100	300	6000	5000	28701	-4126
Sprinkler	3711b	37110	8250b	412	1000	-	600	100	300	6000	20000	9522	-23305
Without irrigation(dry)	3970b	39700	8560b	428	1000	-	-	100	300	6000	0	32827	0

Conclusion:

In the first design increasing moisture of soil solution by irrigation through reduction of soil mechanical resistance and rising growth in root also may provide more absorption of potassium with higher yield. By carrying out irrigation treatments, number of clusters was increased in area unit and yield. Compare the costs for treatments and proceeds from the sale of seeds and wheat straw showed when considering the costs and income per hectare for each treatment compared to the dry-farming treatment, any types not economic, in case of emergency and the need for irrigation and water resources on the other hand offer.

In the 2th design Tables 7, 8 and 9 showed that the treated water would cost only surface irrigation in all subplots. Positive amounts 8970, 4536, 5280 of sub plots without fertilizer and normal amount of fertilizer and 3/2 times the normal were observed.it means in loess soils just watering the soils could create high added value. Using equipment and irrigation systems greatly reduced the economic value of the product.

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