Intensive rainfed and irrigated forage crop production for Mediterranean Italian Buffalo feeding

P. Martiniello¹, G. Gesualdo¹, E. Sabia¹, G.M. Terzano², C. Pacelli³, N. Berardo⁴

¹ CRA- Istituto Sperimentale Colture Foraggere, SOP di Foggia, Foggia, Italy
² CRA- Istituto Sperimentale Zootecnia, Monterotondo, Rome, Italy
³ Dipartimento di Produzione animale, Università della Basilicata, Potenza, Italy
⁴ CRA- Istituto Sperimentale per la maiscoltura, SOP di Bergamo, Bergamo, Italy

Corresponding author: P. Martiniello, C.R.A. ISCF SOP Foggia Via Napoli 52, 71100-Foggia - Tel./Fax: +39.881.741632 - Email: pasquale.martiniello@entecra.it

ABSTRACT: Buffalo intensive husbandry represents the most lucrative dairy activity in Campania Region. The main forage crop system used in this area are based on winter Italian reygrass (Lolium multiflorum Lam.) and spring corn (Zea mays L.). The continuous growing of this crops stressed the soil with a consequent reduction of yield potential. The experiment aimed to assess the agronomic and nutritive feeding value of Italian ryegrass-corn vs other cropping systems (models) based on double rotated legumes and graminaceous crops grown under irrigated and rainfed water supply.

Key words: Silage production, Nutritive value, Forage models, Crops yield.

INTRODUCTION - Buffalo intensive husbandry represents the most common dairy activity in Campania Region (Mengozzi, 2003). The crop system chosen by farmers for forage production depends on the availability of favourable external factors. In this environment winter Italian reygrass and spring sowing corn are the most diffused crops. This system on one hand may be more lucrative, on the other can reduce the ecological potential of soil fertility (Tanaka et al., 2002). The damage caused to the environments by intensive monocultures cropping (e.g. Italian reygrass-corn) may be reduced by adopting rotations with annual or perennial forage crop systems (Pierce and Rice, 1988; Martiniello, 2007). Integrated cultivation of reygrass-corn with other cropping system based on annual winter legume with spring corn or sorghum favours crop production, economic income and reduces ecological pollution. In order to sustain farmer income and protect the environment, the experiments evaluated cropping systems under irrigated and rain-fed conditions. The aims of the experiments were to assess the production (biomass and nutritive feeding value) and impact of cultivation on topsoil in ryegrass-corn system compared with alternative annual or perennial grass and legume species.

MATERIAL AND METHODS - The trials began in 2006 at Foggia (15° 13’E, 41° 18’N and 76 m above sea level) and still go on for evaluating forage yield potential and nutritive
value of cultivations gross product. The crops were evaluated in a cropping system based on two cultivation per year (referred as model) under irrigated and rainfed condition of growing. The models were four and made by the crops reported in Table 1. The crops in the models were four time replicated. Field experiments were established on plot of 120 m². At the beginning of September of 2005, seedbed was prepared by a 35 cm mouldboard plough, fertilized and refined with field cultivator and tine-harrow. The experiment has been arranged in a split-plot design with irrigation in the main plots and models in subplots. The variety of the models in the subplot has been four times replicated. Graminaceous winter sown crops (barley and Italian reygrass) were seeded in rows 0.186 m a part and 20 m long at seed density rate of 180 and 40 kg ha⁻¹, respectively. Small seed legumes (lucerne and clover) were sown (rows, 0.186 m within and 20 m long) at density of 40 kg ha⁻¹ while the density of faba bean and pea was 80 plants m² (rows, 0.38 m a part and 20 m).

Table 1. Winter and spring crops considered in the models of the irrigated and rainfed treatments.

| Type of model | WINTER MODEL UNDER IRRIGATED | SPRING MODEL UNDER IRRIGATED |
|---------------|-------------------------------|-----------------------------|
| Crops Variety | I    II   III   IV            | I     II   III   IV          |
| Lucerne Bella | Reygrass Andrea Marado Vesuvio| Lucerne Corn Sorghum Sorghum|
| Clover Local Ec. | Reygrass Andrea Arda Susan | Sorghum Regulus Nicol       |
| Sorghum       | Sorghum Sorghum Sorghum      | Sorghum Sorghum Sorghum     |

In May, winter crops were harvested and gross product stored as seed (horse and pea), hay (clover and lucerne) and silage (corn, barley, reygrass and sorghum). Yield gross product of the crops was assessed on the harvest of the plot by experimental machinery. Before harvest, were picked up samples for determining moisture at harvest, yield components (stems m⁻², fructiferous organs stem⁻¹, seed per fructiferous organ and harvest index) and chemical analyses for qualitative and nutritive values determinations (MFU). Immediately after winter crops harvests, the plots were ploughed, fertilized with nitrogen and phosphorous (36 and 96 kg ha⁻¹, respectively) and tinned with cultivator and harrow. The corn and sorghum were sown in rows (0.60 m within rows) at density of 10 and 40 plants under irrigated condition for corn and sorghum, respectively. Under rainfed the sorghum density was 38 plants m⁻². When the seedling were at 4 whorl leaves stage the plots were tinned at the exactly plant density, weeded with linuron at rate of 1.3 l ha⁻¹ and nitrogen fertilized with urea, corn 160 kg ha⁻¹ and sorghum with 130 kg ha⁻¹ under irrigated and 110 kg ha⁻¹ under rainfed. In order to favour seedling establishment an aid irrigation was applied after planting. The crops under irrigation treatments were irrigated when evaporation (ET₀) from the crops reached 80 mm. The amount of water supplied by irrigation was 800 m³ ha⁻¹. During the vegetative cycle of crops, 8 irrigations for corn and 5 for sorghum were performed. The harvest of crops for biomass (barley, corn, reygrass and...
sorghum) and seed (faba bean and pea) were made at appropriate phenological stage. The parameters determined were biomass production, yield components (stems m$^{-2}$, harvest index, seed per fructiferous organ) and a sample for chemical analyses determination (crude protein and fibre, acid and neutral detergent fibre, acid detergent lignin, starch, fatty acid and ashes). The milk feeding unit (MFU) was computed according to Chase (1981) procedure. The data has been analyzed according to the statistical techniques of ANOVA and comparison, among irrigation and winter and spring models, are compared using the appropriate error terms.

**RESULTS AND CONCLUSIONS** - The winter dry matter (DM) production under irrigated condition, were 80.6% lower than the models of spring sowing (Table 2). Among winter models, barley crop was 50.8% more productive than Italian reygrass. Corn was the crop more productive of those sown in spring. The dry matter of corn excided those of sorghum varieties Regulus and Nicol 60.4% and 40.2%, respectively. The dry matter of lucerne was 27.6% lower than that of corn and 45.3% and 17.3% higher than Regulus and Nicol sorghum varieties, respectively (Table 2). The winter sowing models of rainfed condition favoured the dry matter production of barley whose amount was 27.7% and 21.2% higher than Italian reygrass and squarrosum clover crops, respectively (Table 3). However, the hay production of clover delays the sowing of the following spring crop with a consequent difficulty to establishment of sorghum seedlings. Furthermore, Regulus because is growing for seed yield rather than forage consumption differed in dry matter production (Nicol silage sorghum was 23.6% higher than seed sorghum Regulus). Delay in seeding of sorghum Nicol after Italian reygrass was a consequence of the reduced (15.0%) dry matter after pea crop (Table 3). The mean dry matter of autumn crops in the models of rainfed condition did not differ from those of irrigated condition. By contrast wider differences (46.4%) were observed in spring models of rainfed vs irrigated condition (Table 2 and Table 3).

| Type of model | DRY MATTER (t ha$^{-1}$) | DRY MATTER (t ha$^{-1}$) |
|---------------|-------------------------|-------------------------|
|               | I   | II  | III | IV  | I     | II   | III  | IV  |
| Silage        | 5.51| 11.20|     |     | 32.66| 12.94| 19.54|     |
| Hay           | ----|     |     |     | 23.64|     |     |     |
| Seed          |     |     |     | 0.53|     |     |     |     |
| MFU kg DM$^{-1}$ | 0.48| 0.49| 0.96|     | 0.63| 0.60| 0.59| 0.60|

The nutritive value of the model was related to the crops considered in the cultivation. The graminaceous winter sowing showed similar MFU values under irrigated condition while legume crops (annual faba bean and perennial lucerne meadow) of the irrigated treatment presented higher MFU than graminaceous crops (Table 2).
The Italian ryegrass-corn (model II), under irrigated condition produced 33.3%, 39.6% and 44.5% wider MFU ha\(^{-1}\) than model I (lucerne meadow), model III (barley-sorghum) and model IV (horse been-sorghum), respectively (Table 4). Conversely, under rainfed, the model V (squarrosus clover-sorghum) produced MFU ha\(^{-1}\) about 2%, higher than the sorghum with Italian ryegrass, pea and barley models (Table 4).

The preliminary results show that the irrigated Italian ryegrass-corn represents the most efficient model for producing dry matter and MFU ha\(^{-1}\), while under rain-fed condition the crops clover-sorghum exploits better than other models the weather condition of Mediterranean climate and allows the possibility to use a legume crop in the system of growing.

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