

**Contratto di ricerca tra DII-UNIPR e Natura Nuova s.r.l. sul tema:
“Semilavorati testurizzati per nuovi prodotti a base di soia e di frutta” (marzo 2011-2013)**

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RELAZIONE SULLE ATTIVITÀ DI RICERCA
EFFETTUATE NEL PERIODO: MARZO 2011 – DICEMBRE 2012

Parte A. Semilavorati Testurizzati per Nuovi Prodotti a Base di Soia

Allegato A.1 - Varietà di soia alto proteiche
sintesi della bibliografia richiamata

Soia - *Glycine max* L.

Atlante delle coltivazioni erbacee - Piante industriali

<http://www.agraria.org/coltivazionierbacee/soia.htm>

Classe: Dicotyledones

Ordine: Leguminosae

Famiglia: Papilionaceae

Sottofamiglia: Papilionatae

Tribuù: Phaseoleae

Specie: ***Glycine max* L.**

Sinonimi: *Soja hispida* Moench. - *Soja max* Piper - *Soja japonica* Savi - *Glycine hispida* (Moench.) Maximowicz - *Glycine soia* Sieb. et Zucc. - *Dolichos max* L. - *Dolichos soja* Jacq. - *Phaseolus hispida* Oken.

W. Shurtleff, A. Aoyag. **History of Edamame, Green Vegetable Soybeans, and Vegetable-Type Soybeans.** *Soyinfo Center, 2009 - 764 pagine* (Estratto in [Allegato A.1.1](#))

Vinton is a “specialty cultivar” which contains about **45%** protein; 100 seeds weigh 22 gm.

Harovinton, tested as OX733, was developed by the Agriculture Canada Research Station, Harrow. This variety was derived from the cross Vinton x Vinton 81, made in 1982. Protein content: higher than Corsoy 79 (**44.9%** vs. 40.9%). The yield of soymilk and tofu per kilogram of Harovinton beans was 4% and 11% greater, respectively, than for Corsoy 79.

The **Proto** soubean (Registration no. CV-275, PI 542,769) was developed at the Minesota Agricultural Experiment Station. It was released on 15 Feb. 1989 as a “special purpose high-protein cultivar for use in the production of tofu and other products requiring very high protein content.” **Proto** contains **45.6%** protein and 16.5% oil.

(Ontario, Canada, 1994) The soybeans with the highest protein content (on a dry weight basis) are **BARC-6 53.4%**, **Harovinton 45.5%**, **Enrei 45.0%**.

(Ontario, Canada, 1996) Soybean protein (highest was **BARC-6** at **53.4%** on moisture-free basis), soymilk protein (highest was 6.1% from AC Proteus), soymilk yield (highest was 5.7 kg/ kg from Maple Arrow), tofu yield (highest was 4.6 kg/kg from Harovinton and Raiden), tofu firmness (highest was 0.42 N/mm from Enrei), tofu rigidity (highest was 1680 G', Pa from Maple Arrow), soymilk viscosity (highest was 7.73 from BARC-6), and soymilk 11S/7S (highest was 5.44 from Secord; It has been reported that soybeans with a high 11S/7S ratio will produce firmer tofu).

(Dupont 1997) **A231QT Optimum** yellow hilum soybean varieties “designed specifically for the soyfood market. It is large seeded, high protein, yellow hilum, and lipoxygenase 2, null” [i.e. lacking the undesirable L2 lipoxygenase enzyme which causes beany flavor]. Quality specifications on a dry matter basis: Seeds/lb: 2100. **Protein: 46.3%**. Oil: 20.6%. Tofu yield 332.6. White index of tofu: 51.6%. Tofu strength: 22.7 gm/sq. cm. Soymilk yield: 4.8 ml/gDS. Solids content of soymilk 11.7%. Protein content of soymilk: 50.3%.

A. Achouri, et al. (2008) **Soybean variety and storage effects on soymilk flavour and quality.** *International Journal of Food Science & Technology*, 43:82-90 ([Allegato A.1.2](#))

Vinton 81 variety contained the highest protein (**45,7%**) and the lowest fat (20,4%).

Michigan Crop improvement association. **Vinton 81 Soybean** ([Allegato A.1.3](#))

Vinton 81 is a group I variety (relative maturity 1.9) released from Iowa Agriculture and Home Economics Experiment Station. It is resistant to races 1 to 3 and 6 to 9 of phytophthora root rot. Vinton 81 was developed for its large seed and high protein. It has an average protein content of **44** to **45%**. It is approved for use as a suitable variety for tofu production.

2007 Soybean Production Conference. University of Minnesota. Extension Update. Owatonna, MN. ([Allegato A.1.4](#))

2006 Food Grade & Special Use Soybean description, 3-site average yield (Hope, Potsdam, and Waseca), and 2-site average (Hope and Potsdam) oil and protein content.

Entry	Description	Hilum	3-Site Average ¹		2-Site Average ²	
			% moisture	bu/A	% oil	% protein
M99-334028	Low lipoxegenase, protein	Buff	13.2	44	16.5	40.4
SurePro	Larger seed, higher protein	Yellow	13.7	40	17.3	39.1
M99-333036	Large seed, higher protein	Yellow	13.3	42	18.0	38.3
SR-53			13.0	44	17.6	38.2
RoyalPro	Larger seed, higher protein	Yellow	13.1	42	17.9	38.1
M98-308007	Large seed, higher protein	Buff	13.7	48	18.5	37.8
M98-308044	Large seed, higher protein	Buff	13.7	44	18.5	37.8
M98-324017	Large seed, higher protein	Yellow	13.1	39	18.2	37.8
SR-67			13.2	43	18.1	37.7
SoyaPro	Larger seed, higher protein	Yellow	13.3	38	17.9	37.6

P. Chen, et al. (2008) **Registration of High-Protein Soybean Germplasm Line R95-1705.** *Journal of Plant Registrations*, 2(1):58-59 ([Allegato A.1.5](#))

R95-1705 originated as an F4 plant selection from the cross of ‘Hutcheson’ × BARC-7. Hutcheson (PI 518664) is a widely adapted and high-yielding mid-maturity group V cultivar derived from the cross V68-1034 × ‘Essex’ (Buss et al., 1988). BARC-7 (PI 555397) is a high-protein maturity group IV line derived from the cross CX797-21 × D80-6931 (Leffel, 1992).

R95-1705 was evaluated for protein and oil contents in 22 environments from 1996 to 2006 in Arkansas. Average protein and oil contents of **R95-1705** were **467 g kg⁻¹** and **178 g kg⁻¹**, respectively.

Erik Dorff (2007) **The soybean, agriculture's jack-of-all-trades, is gaining ground across Canada.** *Statistics Canada (Allegato A.1.6)*

Characteristic	Oil, feed and meal soybeans	Soy milk/tofu soybeans
Seed size	16 g to 19 g/100 seeds	>20 g/100 seeds
Colour	Beige with dark hilum	Very light with clear hilum
Oil content	18% to 21%	17% to 19%
Protein content	36% to 40%	44% to 47%
Soluble sugar content	10% to 11%	11% to 13%
Insoluble sugar content	21% to 25%	21% to 25%
Minerals	5%	5%

A. M. Simpson, J. R. Wilcox (1982) **Genetic and Phenotypic Associations of Agronomic Characteristics in Four High Protein Soybean Populations.** *Crop Science, 23(6):1077-1081*
<https://www.soils.org/publications/cs/abstracts/23/6/CS0230061077?access=0&view=pdf>

Four hundred and twelve soybean [*Glycine max* (L.) Merr.] progenies from crosses between two poorly adapted, high protein strains, 'Pando' (49.9% protein) and PI 159,764 (48.7% protein) and two adapted, average protein strains, High yield was positively associated with late maturity, increased plant height, lodging susceptibility, and resistance to shattering. High protein content was also associated with late maturity and increased plant height in progenies of two crosses and with increased severity of seed coat mottling.

J. Vollmann, et al. (2000) **Environmental and genetic variation of soybean seed protein content under Central European growing conditions.** *Journal of the Science of Food and Agriculture, 80(9):1300-1306 (Allegato A.1.7)*

In soybean genotypes of early maturity groups, average to high protein content (399-476 gkg⁻¹) was found in years with high air temperature and moderate rates of rainfall during the seed-filling period, whereas seed protein content was drastically reduced (range 265-347 gkg⁻¹) in seasons of insufficient nitrogen fixation or higher amounts of precipitation during seed filling. In a set of 60 genotypes, protein content was increased both by late nitrogen fertilisation before the onset of seed filling and by inoculation of seed with nitrogen-fixing rhizobia. Therefore selection of early maturing soybean genotypes with improved seed protein content appears to be feasible and is only limited by the moderately negative correlation between protein content and seed yield. In crosses intended for development of populations with improved protein content, high-protein genotypes such as **cv Proto** or germplasm line **BARC-6** were utilised as protein donor parents.

R. W. Yaklich (2001) **β -Conglycinin and Glycinin in High-Protein Soybean Seeds.** *J. Agric. Food Chem. 2 49, 729-735 (Allegato A.1.8)*

Breeders have used these accessions and released high seed protein lines in which the protein component exceeds **50%** of the seed dry weight. However, two major obstacles have hindered the development of high-protein soybeans for commercial use. Soybean protein is negatively correlated to seed oil and to yield. Wilcox and Cavins found that the protein component of the soybean seed could be increased without significantly affecting yield. **BARC-8** is a high protein content soybean cultivar (**54,5%**) developed by USDA ARS, Beltsville, MD (Leffel, 1992).

J. M.e Jamago, W Peabody, R. L. Nelson. (2006) **Relationship Between Seed Yield and Protein in High Protein Soybean Populations.** *The ASA-CSSA-SSSA International Annual Meetings (November 12-16, 2006)*

http://download.clib.psu.ac.th/datawebclib/e_resource/e_database/agronomy/2006/techprogram/AM06/P26138.HTM

Yield and protein concentration in soybean are generally negatively correlated. The objective of our research is to assess the effectiveness of selecting for high protein among F₂ plants from crosses between high-yielding and high protein parents followed by selection for high-yielding inbred lines to combine high yield and high protein. From 9 high protein F₂ families selected for either high or low yield, 270 F₄ lines were evaluated in 2004. Selecting for high protein in very early generations followed by selection for yield may be an effective strategy for combining both high yield and high protein concentration.

H. B. Krishnan, et al. (2007) **Identification of Glycinin and β -Conglycinin Subunits that Contribute to the Increased Protein Content of High-Protein Soybean Lines.** *J. Agric. Food Chem., 55:1839-1845 (Allegato A.1.9)*

Seed protein concentration of commercial soybean cultivars calculated on a dry weight basis ranges from approximately 37 to 42% depending on genotype and location. A concerted research effort is ongoing to further increase protein concentration. Several soybean plant introductions (PI) are known to contain greater than 50% protein. The results of our study indicate that high-seed protein concentration is attributed to greater accumulation of specific components of β -conglycinin and glycinin subunits presumably mediated by preferential expression of these genes during seed development.

E. L. dos Santos, et al. (2010) **Influence of Genotype on Protein and Oil Concentration of Soybean Seeds.** *Braz. Arch. Biol. Technol., 53(4)793-799 (Allegato A.1.10)*

With a higher availability of glutamine for the seed, there was an increase of protein content. The genotypes were statistically different as far as the protein concentration was concerned, which confirmed that the genotype had influence on the concentration of protein in the seed. Oil and protein concentrations were inversely related when a variation of glutamine concentration occurred.

H. B. Krishnan, R. L. Nelson. (2011) **Proteomic Analysis of High Protein Soybean (Glycine max) Accessions Demonstrates the Contribution of Novel Glycinin Subunits.** *J. Agric. Food Chem. 59:2432-2439 (Allegato A.1.11)*

Seed protein concentration of commercial soybean cultivars calculated on a dry weight basis ranges from approximately 36 to 42% depending on the genotype, location, and growth conditions. While this amount of seed protein is high compared to other seed crops, an ongoing concerted research effort has been established to further increase soybean seed total protein concentration. This effort is essential since the demand for quality soy seed protein and its products, has increased steadily for decades and is not expected to decline. Results showed that among the majority of the nine accessions, the largest difference in higher protein quantity was within the seed 11S storage globulins. In the germplasm evaluation test, the protein concentrations ranged from **48.4** to **52.2%**, and in the second experiment, the range was **46.1** to **50.8%**.

L. M. Paucar-Menacho, et al. (2010) **A high-protein soybean cultivar contains lower isoflavones and saponins but higher minerals and bioactive peptides than a low-protein cultivar.** *Food Chemistry* 120:15–21 (Allegato A.1.12)

The objective was to compare the bioactive compounds of a low-protein (BRS 133) soybean in comparison to a high-protein (BRS 258) soybean cultivar. The high-protein soybean contained 17% lower carbohydrates and a lower chemical score (63) in relation to the low-protein soybean, which had a higher chemical score (76), associated with the higher methionine content (1.2%). Cultivar BRS 258 had more calcium (15.5%), phosphorus (30.1%), iron (18.7%), copper (9.0%) and zinc (11.5%), and a higher concentrations of lunasin, BBI and lectin (20.3%, 19.0% and 27.1%, respectively) than the low-protein cultivar. BRS 133 had 75.4% higher concentration of total isoflavones (5.1% of total aglycones) and 31.0% total saponins, as compared to BRS 258. It was concluded that the low-protein soybean cultivar contained higher isoflavones and saponins, but lower levels of minerals and bioactive peptides, such as lunasin.

Regione Emilia Romagna. **Norme Tecniche di Coltura: Soia – 2009** (Allegato A.1.13)

Varietà di soia consigliate sulla base dei risultati dei campi sperimentali realizzati dal CRPV in Emilia-Romagna:

Altapro (SIS) - GM 0+ - Varietà ad elevato contenuto di proteine, con tegumento ed ilo completamente bianco. Varietà ideale per l'utilizzo industriale nella preparazione di alimenti destinati al consumo umano.

Royalpro (SIS) - GM 1 - Varietà ad elevato contenuto di proteine, con tegumento ed ilo completamente bianco. Varietà ideale per l'utilizzo industriale nella preparazione di alimenti destinati al consumo umano.

Shama (Syngenta Seeds) - GM 1 - Varietà ad elevato contenuto proteico.

Risultati delle sperimentazioni in Friuli V.G. e Emilia Romagna. ERSa (Allegato A.1.14)

In Friuli, la cultivar **PR92B63** (Pioneer) abbina alto contenuto di proteine (**42,2%**) e resa superiore alla media (indice 106). La varietà **ENERGY** (RV Venturoli), invece, ha contenuto proteico leggermente inferiore (41,3%) ma resa inferiore alla media (indice 89).

In Emilia-Romagna, le varietà **EIKO** (Agroqualità) e **ENERGY** (RV Venturoli) hanno fornito il più alto contenuto proteico (**43,6** e **43,5%**) e con resa superiore alla media (rispettivamente, indice 121 e 104). Le varietà **CELINA PZO** (Apsovsementi) e **INDIAN** (RV Venturoli) hanno contenuto proteico paragonabile (rispettivamente, 43,1 e 43,0%), ma resa inferiore alla media (rispettivamente, indice 97 e 90).

Northland Seed & Grain's Soybean Seed Varieties Appred For Registration in Italian and EU Seed Catalogs - Northland Seed & Grain Corporation, *NPI Center - Apr. 3, 2006*

<http://newhope360.com/northland-seed-grains-soybean-seed-varieties-approved-registration-italian-and-eu-seed-catalogs>

Northland Seed & Grain Corporation, based in Minnesota, USA and S.I.S. (**Società Italiana Sementi** S.p.A.), based in Bologna, Italy, are proud to announce that Northland's high protein soybean seed varieties **Royalpro®**, **Soyapro®**, **Minnpro®**, **Altapro®** and **Toyopro®** have all been approved for registration in the Italian and EU seed catalogs. Northland's Non-GMO and Organic specialty soybean varieties were developed specifically for characteristics most desired by food manufacturers of soymilk, tofu, soy sauce, soy proteins and other soy food applications.

SIS - Società Italiana Sementi

http://www.sisonweb.com/it/prodotto_indice.php?catProd=4

Soia **VITAL**, alto contenuto proteico e ad ilo bianco. Dato medio: **Proteine 43,1%**.

Soia **LUNA**, alto contenuto proteico e ad ilo bianco (ha sostituito la precitata varietà ALTAPRO Northland) (*non sono presentati dati analitici*).

Guerresi Sementi

<http://www.guerresisementi.it/oleaginose/soia.html>

Soia **CLEOPE** - indicata per coltivazioni Biologiche, con alto valore proteico (48/52%).

Apsovsementi

<http://www.apsovsementi.it/notizie/Soia.pdf>

Soia **CELINA PZO**, con i dati medi di proteine (39,4%) delle prove ERSa nel biennio 2010-2011.

DuPont - Pioneer

<http://www.agronomico.com/Prodotti/Soia/PR91M10.aspx>

Soia **PR91M10** elevato contenuto di proteine. (*non sono presentati dati analitici*)

Sipcam Italia (Agroqualità)

<http://www.sipcamitalia.it/Soia.cfm?lang=it>

Soia **NIKKO** elevato contenuto di proteine. (*non sono presentati dati analitici*)

RV Venturoli

<http://www.rv-venturoli.com/prodotti/soia.html>

Soia ATLANTIC, INDIAN e ENERGY, senza alcuna indicazione relativa al contenuto proteico

Agroservice

<http://www.agroservicespa.it/index.php?page=prodotti&lng=IT&idca=14&idp=77>

Soia TEA, FORTEZZA e CONDOR, senza alcuna indicazione relativa al contenuto proteico

Syngenta

<http://www.nk.com/it/soia/>

Soia BRILLANTE, DEMETRA, GIULIETTA e GAIA), senza alcuna indicazione relativa al contenuto proteico

Commissione Europea. **Catalogo Comune delle Varietà delle Specie di Piante Agricole**. Trentunesima edizione integrale (2012/C 402 A/01)

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2012:402A:0001:0686:IT:PDF>

Glycine max (L.) Merrill pagg. 261-269

Sono elencate circa 120 varietà di soia registrate in Italia, senza indicazioni compositive.